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ENVIRONMENTAL SURVEY OF TWO INTERIM DUMPSITES MIDDLE ATLANTIC BIGHT. SUPPLEMENTAL REPORT

Donald W. Lear

Environmental Protection Agency
Annapolis, Maryland

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ENVIRONMENTAL SURVEY OF TWO INTERIM DUMPSITES

MIDDLE ATLANTIC BIGHT

SUPPLEMENTAL REPORT

OCTOBER 1974

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION III
PHILADELPHIA, PENNSYLVANIA 19106

SUPPLEMENTAL REPORT

ENVIRONMENTAL SURVEY OF TWO INTERIM DUMPSITES

MIDDLE ATLANTIC BIGHT

OPERATION "FETCH"

Cruise Report 5-10 November 1973

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ABSTRACT

Supplemental data from an environmental survey of two interim dumpsites in the Mid-Atlantic Bight are reported. Carbon and iron distribution in the water column, zooplankton populations, metals in echinoderm and mollusc tissues are reported, and the significance of their distribution discussed.

PREFACE

The issuance of permits for ocean disposal of wastes requires the Environmental Protection Agency to know the environmental consequences. Regularly scheduled cruises have been sponsored by EPA, Region III, to evaluate the effects of acid waste disposal and municipal sewage disposal on two adjacent ocean dumpsites off the Delaware-Maryland coast.

Oceanographic cruises were initiated in May 1973 (Palmer and Lear, 1973) followed by a fall cruise (Lear, Smith and O'Malley, 1974). The report for the latter cruise, Operation "Fetch", was issued when most, but not all, of the analytical results were complete. This supplementary report presents the remaining results from that cruise.

The EPA National Water Quality Laboratory, Narragansett, Rhode Island, especially Dr. Gerald Pesch and Bruce Reynolds, have materially aided Region III in design and execution of the program. The interest and cooperation of the oceanographic fraternity outside EPA has been outstanding. The Marine Science Consortium, Lewes, Delaware, has freely loaned gear and expertise. The University of Delaware Marine Laboratory, Lewes, Del., especially Dr. Donald Maurer, has been more than generous with special expertise. Dr. Michael Champ, American University, not only provided shipboard assistance, but performed the carbon and iron analyses reported herein. Dr. Harold Palmer and Joe Forns Westinghouse Ocean Research Laboratory, Annapolis, Maryland, have given freely of advice, assistance, and the loan of gear. In addition, many

others, in and out of government, have contributed the ability and gear tc the development of the ocean dumping monitoring program. EPA is extremely gratified to have the invaluable assistance of all of these groups in our common concern for the management of the oceanic environment.

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SUMMARY AND CONCLUSIONS

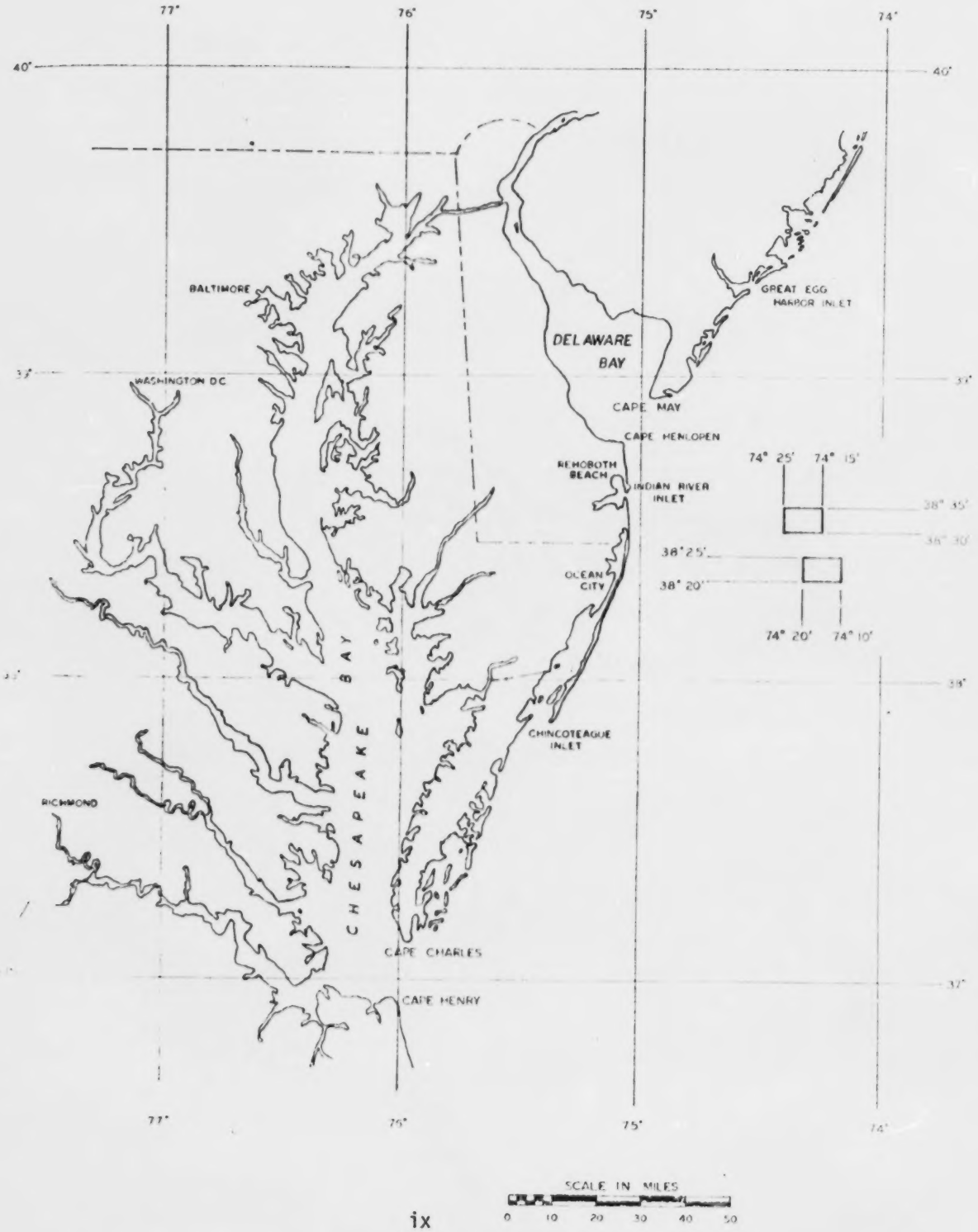
1. Dissolved and particulate organic carbon accumulations were not evident in the water column under the conditions studied. Such materials are probably dependent upon time of latest release of materials, as well as a cumulative function of time.

2. Particulate and dissolved iron showed no patterns of distribution in the water column, in spite of the weak thermocline.

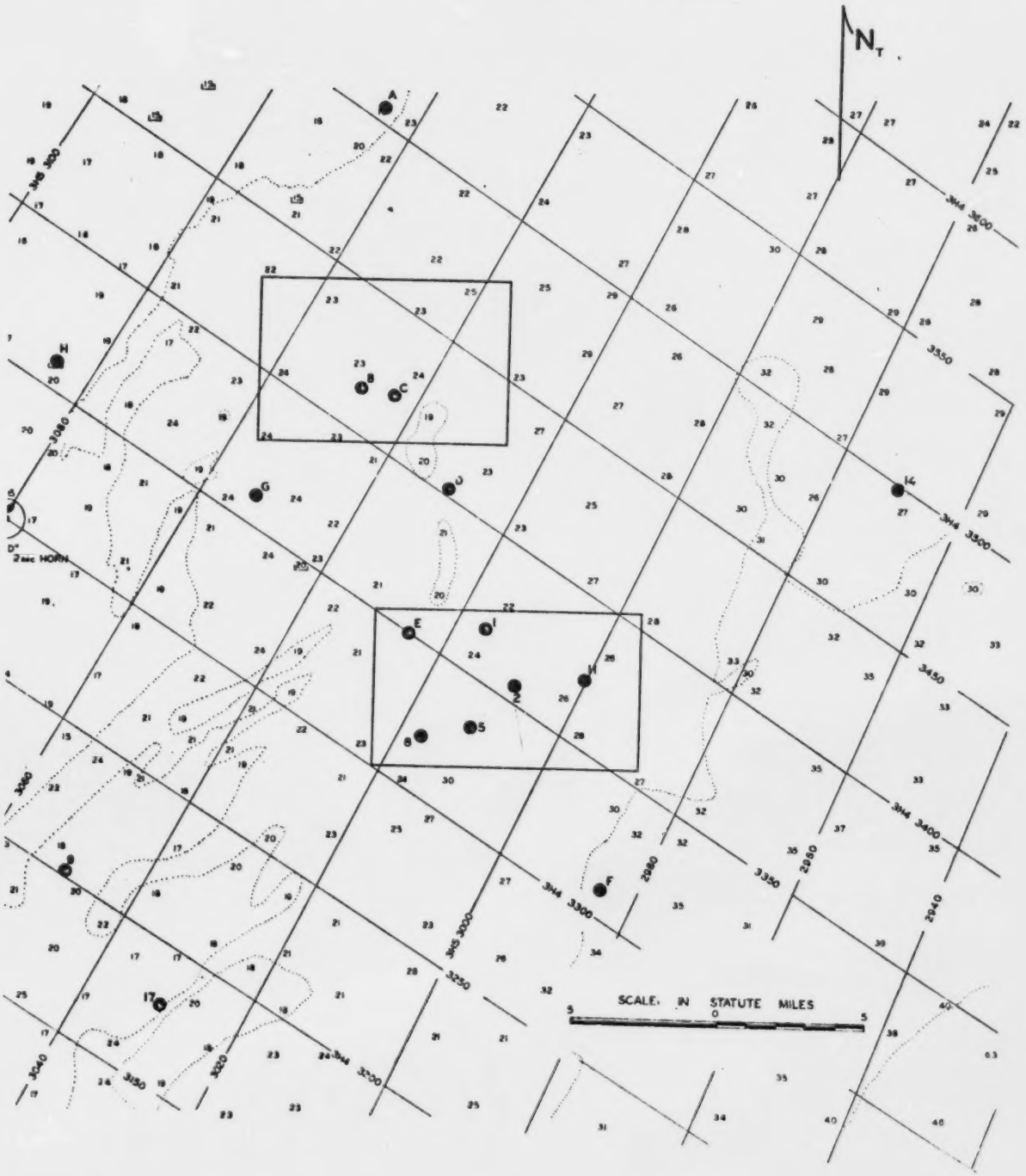
3. Conclusions drawn from a statistical treatment of the results show (1) that metals thus disposed of do accumulate in the tissue of benthic organisms and in quantities roughly proportional to the amounts dumped; (2) that certain metals, particularly V and Cd, are dumped in such quantities in one of the two sites such that they may be used as tracers for that dumpsite; and (3) that, due to hydrographic conditions, the effects of these dumped materials is in no way limited to the area bounded by the dumpsites proper but are spread over a large area, as yet undetermined, particularly in the direction of the prevailing currents. A much larger sample grid is needed to establish the extent of this area.

4. Zooplankton populations at the two stations examined showed no effects of stresses.

AREA OF STUDY



STATION LOCATIONS



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PART I

DISSOLVED AND PARTICULATE ORGANIC CARBON

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The American University
and
Donald W. Lear, EPA Region III
Annapolis Field Office

Ocean disposal of sewage sludge should result in an increase of organic and inorganic nutrients in the dump area. As this new input feeds into the naturally occurring marine organic carbon cycle, it may affect this dynamic process. The impact of the introduction of organic matter in the form of sewage material in aquatic ecosystems has been well documented and usually correlates with species specific reactions (Beeton, 1961; Butcher, 1960; Hynes, 1960; Wilhm and Dorris, 1968; Florida Ocean Sciences Institute Report, 1971). The dispersion of dissolved and particulate organic carbon in the water column as it is ocean-disposed by barge as sewage sludge (or created by the sludge) has only recently been investigated (Champ 1974).

Dissolved (DOC) and Particulate (POC) organic carbon analyses were conducted during Operation "Fetch" to collect data during the fall (November) mixing period. The broad base of biological, chemical, and physical parameters and indices investigated during Operation "Fetch" will allow greater insight into the impact of ocean disposal of sewage sludge on the dumpsite ecosystem.

Materials and Methods

Frozen water samples prior to filtering were allowed to thaw at room temperature. Each water sample was filtered through a precombusted

Gelman Type-A glass fiber filter for the partitioning of POC and DOC. The DOC and POC were determined by modifications of the method developed by Menzel and Vaccaro (1964) and Fredericks and Sackett (1970).

A step by step description of this method (Champ 1974) is listed:

1. Two 150 ml water samples were frozen in glass stoppered acid-cleaned bottles (Standard Methods for the Examination of Water and Wastewater).

2. Ten ml glass ampules (Owens-Illinois) were prepared for use by being tapped upsidedown on a clean surface (to remove any particles of foreign material) and the top of the neck of the ampule wrapped with a piece of lightweight (one-inch square) aluminum foil twisted to form a cover for the ampule. Ampules were precombusted at 550°C for four hours.

3. Gelman Type-A (0.3 micron) glass fiber filters (25 mm diameter) were precombusted at 400°C for four hours. Filters were handled only with clean forceps.

4. Frozen water samples were allowed to thaw at room temperature prior to filtering and scaling.

5. Four precombusted glass ampules were required for each water sample, giving replicate analysis for DOC and POC. To each ampule 0.2 grams of potassium persulfate and 0.25 ml of 6% phosphoric acid solution were added prior to addition of the sample.

6. Before filtering, samples were briskly shaken.

7. One hundred ml aliquots of water sample were filtered by vacuum through millipore lock-on syringe filter holders containing precombusted Gelman glass fiber filters.

8. The two filters (each containing 100 ml of POC) were air dried with a water aspirator and inserted in ampules. Distilled water (5 ml) was then added to each POC ampule.

9. Five ml aliquots of filtrate were then added by syringe to the ampules for DOC analysis.

10. Filled ampules were purged of inorganic carbon constituents for four to six minutes with purified oxygen (400°C) flowing at a rate of 60 ml/min, and then sealed in a special apparatus to prevent CO_2 contamination from the sealing flame.

11. Sealed ampules were heated at 125°C for four hours in an autoclave to oxidize organic carbon to carbon dioxide.

12. The carbon dioxide content of each ampule was then analyzed in a special ampule breaking apparatus which permits the carbon dioxide to be flushed through an infrared analyzer.

The carbon dioxide content of each ampule was determined by flushing the gas content of the ampule with nitrogen into the gas stream of a non-dispersive infrared analyzer sensitized to carbon dioxide. The detector output of the analyzer was recorded as a peak on a potentiometric strip chart recorder equipped with an integrator standard carbon dioxide conversion.

Graphs are made by plotting the integrated area versus carbon for standardized sodium carbonate solutions. These values were made by injecting a known volume of the sodium carbonate standard through a rubber septum in a special vial containing phosphoric acid solution.

TABLE 1

DISSOLVED (DOC) AND PARTICULATE (POC) ORGANIC CARBON CONCENTRATIONS(mg/1) FOR INDICATED DEPTHS (METERS) AND STATIONS, OPERATION FETCH, NOVEMBER, 1973

Station E			Station F			Station [illegible]		
Depth	DOC	POC	Depth	DOC	POC	Depth	DOC	POC
11	1.08	.185	9	----	-----	3	2.29	-----
22	1.35	.231	21	1.76	.130	17	1.87	.144
34	1.31	.290	62	-----	-----	29	0.94	.370
46	0.10	.530						

Station 17			Station 8			Station 5		
Depth	DOC	POC	Depth	DOC	POC	Depth	DOC	POC
3	----	-----	9	0.94	.240	8	4.75	.328
17	1.44	.169	18	0.94	.240	39	0.96	.071
34	1.10	.181	46	1.95	.067	53	1.02	.250

Station 2			Station 14			Station 11		
Depth	DOC	POC	Depth	DOC	POC	Depth	DOC	POC
8	1.28	.097	5	1.37	.103	9	2.90	.220
23	2.50	.300	18	2.50	.300	18	1.08	.250
46	1.60	.260	34	0.60	.340	45	2.47	.067

Station B			Station A			Station D		
Depth	DOC	POC	Depth	DOC	POC	Depth	DOC	POC
7.6	1.02	.116	8	1.80	.231	9.1	1.00	.260
21.3	1.13	.151	40.2	1.16	.099	18.3	1.84	.160
						38.1	0.84	.137

The organic carbon concentration of each ampule was determined by comparing the integrated area to the standard carbon dioxide conversion graph.

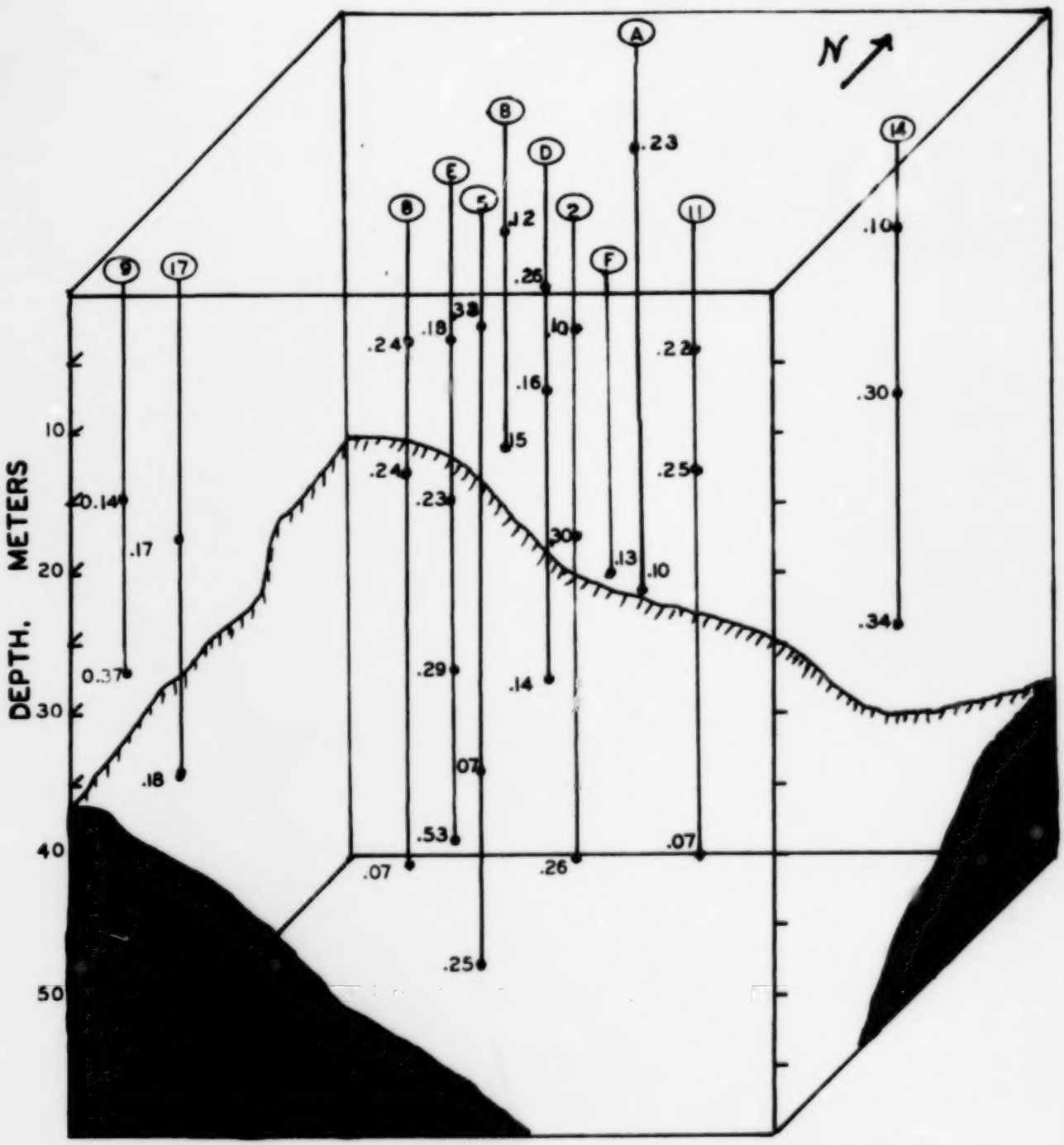
The deviation for duplicated DOC determination on the same water sample was generally 5% or lower, with POC usually 10% or lower. A reagent blank value was determined with each set of water samples sealed. The DOC reagent blank value usually varied from 0.003 mg C to 0.004 mg C. The POC reagent blank usually varied from 0.003 mg C to 0.006 mg C.

Results and Discussion

Results of the analyses are shown in Table 1 and the diagramatic Figures 1 and 2. Two way analysis of variance (Freund, 1970) with respect to depth and sampling site within the dumpsites and outside the dumpsite were conducted. No significant variations for either dissolved or particulate organic carbon at the .95 level could be determined.

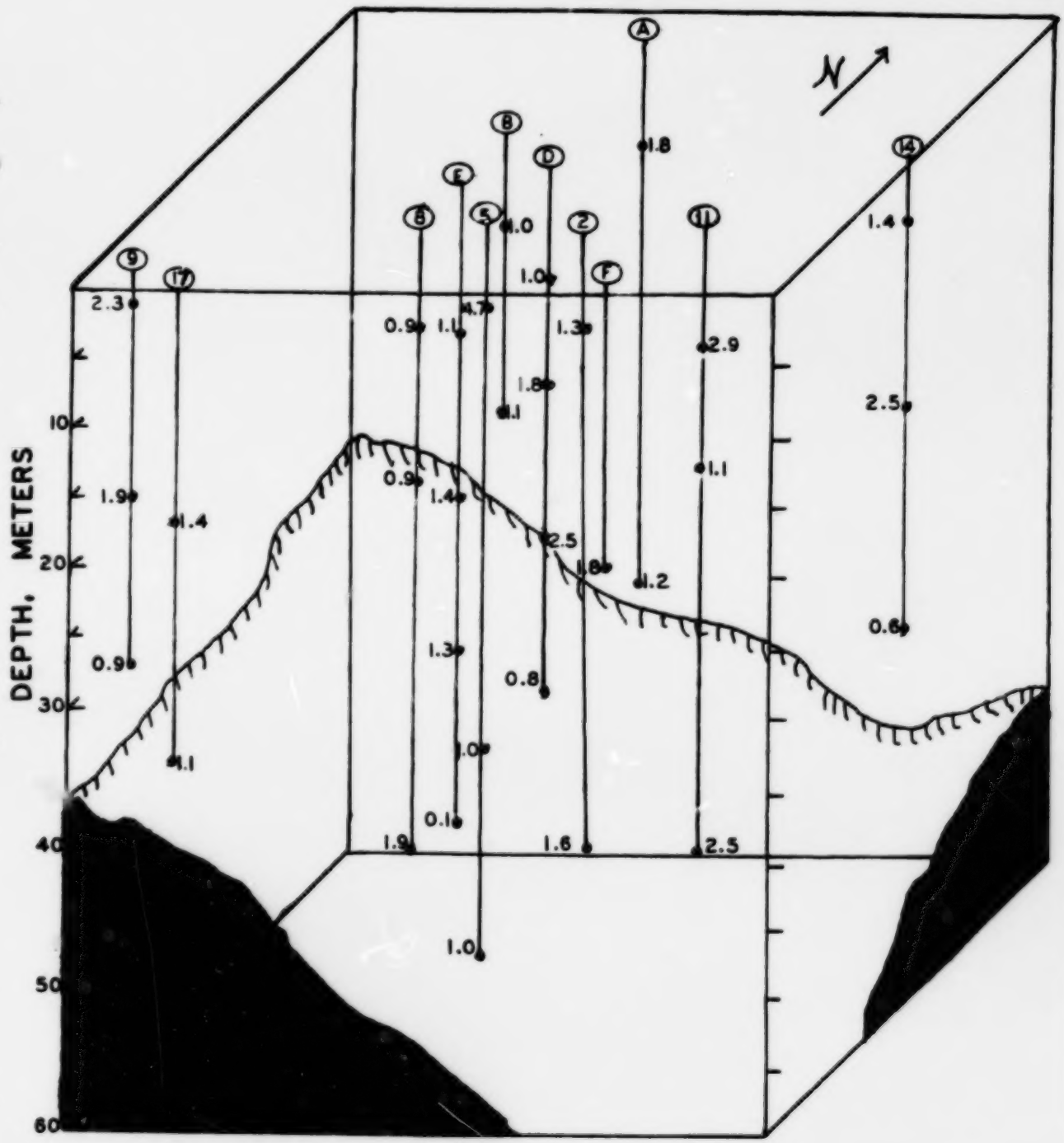
Means for particulate organic carbon concentrations at the thermocline have significant difference in variation (t-test) between those within the dumpsite (Stations E, 8, 5, 2, 11) and three stations outside the dumpsite (Stations 17, 14, D). These differences would suggest an accumulation of particulate organic carbon along the thermocline. Further studies are required to determine the fate of this material. Additional t-tests with DOC and POC at various depths have no significant results at the .95 level.

Values for POC are similar to values reported for the North Atlantic Ocean (Szekielda , 1968; Gordon, 1970). DOC concentrations reflect a



PARTICULATE ORGANIC CARBON (mg/l)

FIGURE 1



DISSOLVED ORGANIC CARBON (mg/l)

FIGURE 2

range of values found in many of the oceans, particularly off the coast of Peru and in the Gulf of Mexico (Hobson, et al, 1973).

The lack of significant differences in variation of DOC and POC with depth and station location (space) on two-way analysis support the conclusions of Menzel and Goering (1966) and Menzel (1967) concerning homogeneity in depth, space and time. It should be noted, however, that other researchers have reported variations in these dimensions (Wangersky and Gordon, 1965; Hobson, 1967; Gordon, 1970). The addition of sewage sludge may be affecting this natural homogeneity and maybe just one external process is affecting the distribution of organic carbon in the oceans, particularly along the thermocline.

The time since last release of sludge would most probably be a factor in the detection of the materials, but must be evaluated by studies designed for the measurement of short-term, rather than long-term effects.

PART II

PARTICULATE AND DISSOLVED BIOLOGICAL IRON

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Iron is one of the major contributed components of both the acid wastes and the municipal sludge disposed in this area. For this reason it may be a tag for the dispersion and distribution of other components of the wastes. The role of iron in the marine environment is considered to be associated with coastal sedimentation and primary productivity. Total iron can be partitioned into dissolved and particulate fractions which are arbitrarily designated by filtration. Dissolved iron complexes as ferric hydroxide and phosphate particles. These are soluble and/or pass through a 0.45μ Millipore HA Filter (Strickland and Parsons, 1973). The uncomplexed ferric ion does not exist in measurable amounts in seawater due to the pH levels. Ferrous forms can only occur under anaerobic conditions.

Dissolved and particulate biological iron is iron that is available to marine organisms. This biologically reactive or available iron is determined by preliminary treatment with 0.48N hydrochloric acid. Such treatment will liberate ferric iron and thus give less of an overestimation of the immediately available biologically active iron than would a total iron figure.

Samples were retrieved from 10-liter PVC Niskin bottles on the hydrocasts, taken as time and weather permitted. Only the waters from

and near the sludge release zone were sampled; the northern region was not sampled due to the exigencies of priority on the schedule.

Materials and Methods

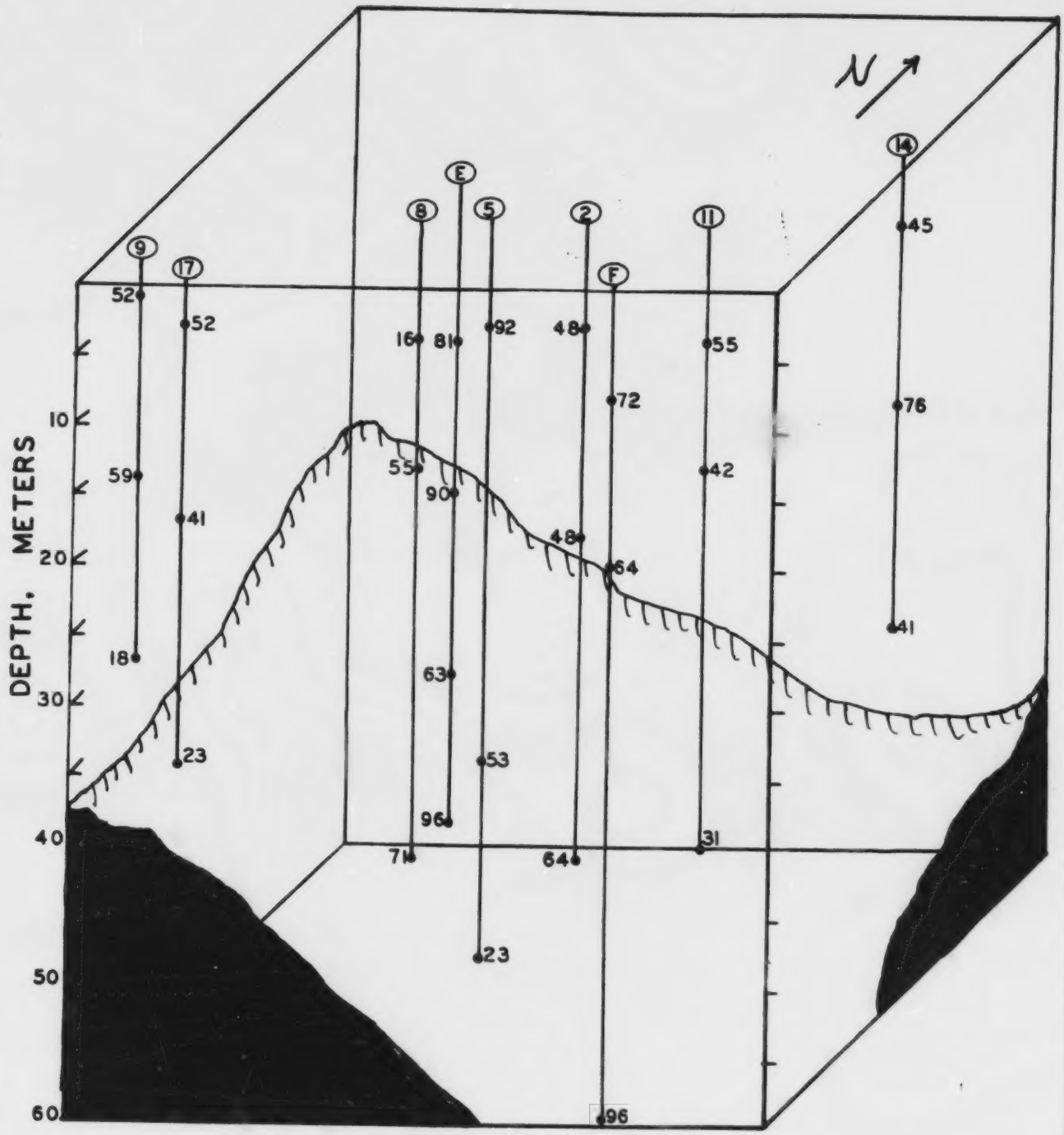
Dissolved and particulate biological iron analysis were cond cted on one-liter samples according to procedures of Strickland and Parsons, 1972; and Izzo, 1974. The one-liter sample was filtered through a 0.45μ Millipore HA Filter to separate dissolved iron (the filtrate) from particulate iron (the non-filtrate). The filters were allowed to partially air dry by the vacuum created by the pump, then each was stored in a Millipore plastic case for transport to the laboratory. One hundred mls of the filtrate were immediately transferred to specially cleaned bottles and frozen for transport to the laboratory where colorimetric analysis was conducted after treatment with 0.48N HCl.

Results and Discussion

Results are shown in Table 1 for particulate biological iron (PBFe) and dissolved biological iron (DBFe). PBFe is also shown diagramatically in Figure 1.

As can be noted in Table 1, nearly all the iron was retained on the filters, as could be expected from the solubility of iron salts in seawater.

The diagramatic distribution of particulate iron in the waters show no definitive pattern in spite of the weak thermocline (Lear, Smith, O'Malley, 1974), but is useful for establishing the relative ambient concentrations and spatial variability. These distributions, however, can be extremely useful for following discrete dumping (Champ, 1974).


N
DEPTH, METERS
10
20
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40
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9
17
E
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F
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14
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52
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81
92
48
55
45
72
76
59
55
90
42
41
48
64
18
63
53
23
96
71
64
31
23
96
PARTICULATE BIOLOGICAL IRON (mg/l)
STATION NO.

FIGURE 1

Table 1

DISSOLVED (DBFe) AND PARTICULATE (PBFe) BIOLOGICAL IRON (µg/l) AT INDICATED DEPTHS (METERS) AND STATIONS, OPERATION FETCH, NOV. 1974

Station E			Station F			Station 9		
Depth	DBFe	PBFe	Depth	DBFe	PBFe	Depth	DBFe	PBFe
11	x	81.20	9	x	72.50	3	0.00	60.90
22	x	89.90	21	x	63.80	17	0.63	59.16
34	x	62.64	62	x	95.70	29	--	17.98
46	x	95.70						

Station 17			Station 8			Station 5		
Depth	DBFe	PBFe	Depth	DBFe	PBFe	Depth	DBFe	PBFe
3	1.08	52.20	9	0.16	16.24	8	--	92.22
17	0.00	41.18	18	0.00	55.10	39	2.19	53.36
34		23.20	46	0.31	71.34	53	--	23.20

Station 2			Station 14			Station 11		
Depth	DBFe	PBFe	Depth	DBFe	PBFe	Depth	DBFe	PBFe
8	0.00	48.14	5	3.90	45.24	9	0.00	54.96
23	1.09	47.56	18	0.00	75.98	18	1.11	41.76
46	--	63.80	34	--	41.18	45	0.00	30.74

x = Sample bottles broken in rough seas

-- = Sample lost in freezing

PART III

METAL CONCENTRATIONS IN THE OCEAN QUAHOG, *Arctica islandica*

Bruce Reynolds and Gerald Pesch
National Water Quality Laboratory
EPA Narragansett

Abstract

Tissue of the clam, Arctica islandica, were analyzed for accumulated concentrations of 12 metals at 14 stations distributed about an industrial waste dumpsite and a sewage waste dumpsite. Conclusions drawn from a statistical treatment of the results show (1) that metals thus disposed of do acculuate in the tissue of benthic organisms and in quantities roughly proportional to the amounts dumped; (2) that certain metals, particularly V and Cd, are dumped in such quantities in one of the two sites such that they may be used as tracers for that dumpsite; and (3) that, due to hydrographic conditions, the effects of these dumped materials is in no way limited to the area bounded by the dumpsites proper but are spread over a large area, as yet undetermined, particularly in the direction of the prevailing currents. A much larger sample grid is needed to establish the extent of this area.

Results and Discussion

Of the stations visited on the "Fetch" cruise, November 5-10, 1973, 14 of these yielded the ocean quahog, *Arctica islandica*. Three of these, Stations A, C, and H, yielded only one individual with the other 11 stations yielding from 3 to 13 individuals. These were subsequently subjected to atomic absorption spectrophotometric analysis for tissue concentrations of 12 metals. The metals, the means and ranges of their

concentrations, and the sample sizes, are reported in Appendix 1 along with values for the other organisms collected.

An analysis of variance was performed on the replicates of Arctica samples for each of the 12 metals for the above set of 11 stations. The results of this test are reported in Table 1.

Table 1

Analysis of Variance of Metal Concentrations

Metal	F ratio	Significance level
Vanadium	5.77	<.1%
Chromium	3.73	<.1%
Cadmium	3.49	.5%
Aluminum	2.95	.5%
Manganese	2.25	5%
Lead	2.20	5%
Zinc	1.24	>20%
Nickel	1.22	>20%
Copper	1.05	insig.
Cobalt	0.96	insig.
Iron	0.48	insig.
Silver	0.31	insig.

Thus, of the 12 metals examined, 6, i.e., V, Cr, Cd, Al, Mn, and Pb, clearly demonstrate significant differences within the set of 11 stations. Of the remaining, zinc and nickel approach significance

while all of the metals show interesting distributions when the mean concentrations are plotted.

Subsequently, Duncan's New Multiple Range Test was performed and homogeneous subsets determined for the set of 11 stations and for the metals shown to have significance. Homogeneous subsets are herein defined as subsets of elements, no pair of which differ by more than the shortest significant range for a subset of that size. The subsets thus determined are presented in Table 2.

Table 2

Homogeneous Subsets of Stations by Metal

Metal	Subset 1	Subset 2	Subset 3
Vanadium	14,8,5,E,D,11,2,1	17,G,9	2,1,17,G
Chromium[1]	2,D,8,14,1,17,11,5	5,G,E,9	14,1,17,11,5,G
Cadmium[2]	G,9,8,D,1,2,E,11	11,17,5,14	1,2,E,11,5
Aluminum	all but Sta. G	G is significantly higher	
Manganese	all but Sta. G	G is significantly higher	
Lead	2,14,3,9,1,G,7,8, 11,5	8,11,5,E	----------

[1] a fourth subset was established as follows:
14, 17, 11, 5, G, E

[2] a fourth subset was established as follows:
2, E, 11, 17, 5

In the following section, these subsets as well as the isopleths for the calculated means of metal concentrations for both the 11-station and 14-station sets are presented as figures. In the isopleth figures, the number beside each of the station numbers are the calculated me in ppm dry weight for the indicated metal extracted from Arctica tissue. It should be emphasized that the subsets and isopleths plotted are limited in areal extent, not only by the existing data, but by the spatial distribution of the sample sites and do not imply a bounded system. It would be expected that the homogeneous subsets would be enlarged if information on additional stations were available. In Table 3, the annual input of waste materials into the respective dumpsites are presented. The individual metal values for the DuPont waste are calculated using the analysis values contained in DuPont's permit application. The Philadelphia values are calculated from an analysis of sewage sludge supplied to our laboratory by EPA Region III, except as indicated. The specific gravity and wet/dry weight ratios used in these calculations were also determined by our laboratory from the submitted samples.

Table 3

Annual Input Delaware Dumpsites

DuPont	Total Input	Philadelphia
240,000,000	gal/yr	150,000,000
908,500,000	l/yr	568,000,000
1.18	spec grav	1.03
1,072,000,000	kg/yr	584,500,000

Table 3 (cont.)

Annual Input Delaware Dumpsites

	DuPont	Specific Metal Input	Philadelphia
Fe	53,400,000	kg/yr	946,000
Cu	3,634	"	83,150
Cr	33,160	"	75,670
Al	745,000	"	1,094,000
Ag	136	"	2,314
Mn	1,017,500	"	81,400
Pb	11,900	"	145,000
Co	9,630	"	8,740
Ni	8,540	"	41,655
V	155,400	"	2.226
Cd	236	"	6,200
Zn	33,400	"	334,000
Ti	1,844,000	"	5,851

Vanadium

Of the metals examined, vanadium presents the greatest significance of variation between stations or groups of stations. From Table 3, it may be noted that the vanadium input to the dumpsite system is approximately 75 times greater for DuPont than for Philadelphia. From Figures 1, 2 and 3 it may be similarly noted that the area of greatest impact of accumulated vanadium in the ocean quahog is in and near the DuPont site and, quite strikingly, in the area to the southwest or downstream (according to prevailing currents discussed in the main body of this report) of the DuPont dumpsite. On the other hand, the Philadelphia site uniformly and without exception shows levels that are significantly lower. It may also be noted that at the three stations, A, C, and H, which yielded only a single sample each and consequently do not lend themselves to statistical treatment, nevertheless show values which seem to fit the general contouring trend.

Chromium

The apparent chromium distribution in Figures 4, 5, and 6 is somewhat complicated by the fact that the metal is deposited in the two dumpsites at levels differing only by a factor of 2 (Philadelphia more than DuPont from Table 3) and thus cannot reasonably be used as a tracer for either dumpsite. The dominant feature in these figures is the demonstration, again, of the effects of the general oceanic circulation in the area to widely distribute the metal to downstream or to the southwest and hence substantially out of the established dumpsite area.

Cadmium

The results of the cadmium determination show identical but reciprocal distribution patterns as compared to vanadium. In this case, cadmium is deposited at a rate approximately 30 times greater in the Philadelphia site than in the DuPont site, (Table 3), and is clearly accumulated in the ocean quahog to a greater degree in the Philadelphia site, (Figure 7, 8 and 9). Again the metal levels were found to be distributed in response to the direction of the prevailing bottom currents. Thus we have two metals which differ significantly in the amounts annually deposited in the system at the two respective sites, and which evidently show promise as tracers in delineating the effects of these two closely related sites--effects, however, that are so widely dispersed beyond the actual dumpsite limits that they do not appear to be contained by the limits of the present sample grid.

Aluminum

At the time of the writing of this report, the Philadelphia sewage sludge had not been analyzed for aluminum content and thus does not appear in Table 3, however the value would not be expected to approach the amount in the DuPont waste for to do so would mean a value approximately that of the iron. If this proves to be the case, the familiar trend of shellfish accumulation paralleling the differential rate of deposition, as well as the extentions of the higher values to the southwest, is again demonstrated.

Manganese

Manganese is deposited at the DuPont site in amounts 12 times that in the Philadelphia site and isopleths plotted in Figures 12, 13 and 14 reflect this fact. However, the plots of the homogeneous subsets show primarily that most of the statistical significance is attributable to the high values for Station G, southwest of the DuPont site.

Lead

The Figures 15 and 16 for lead show trends similar to those established for the other metals with the possible exception that, statistically, the homogeneous subset of stations with high values is limited quite closely to the Philadelphia site, the area of primary deposition. It is equally possible that this delimiting is an artifact of the sample grid.

Titanium

The variance between stations was found to be significant at the 1% level with a F ratio of 2.70. (These values may be compared to those for the other metals in Table 1.) The homogeneous subsets, defined by the multiple range test, are the same as those defined for aluminum and manganese, such that Station G is significantly higher than the remaining stations with the latter falling into one homogeneous subset. These trends are illustrated in Figures 23 and 24. Consequently, the comments made for manganese apply equally well for titanium, particularly since the annual amounts disposed of are more than 3000 times greater for the DuPont site than for the Philadelphia site.

Other Metals

The remaining metals, although not meeting the tests for significance of variance due in part to the sample sites and their limited spatial distribution, nevertheless continue to demonstrate at least portions of the comparative patterns of deposition, lateral transportation, and biological accumulation as found in previous metals. It is particularly noteworthy that in no case does the area of highest accumulation fail to correspond to the dumpsite with the greater load of the respective metal.

STATION LOCATIONS

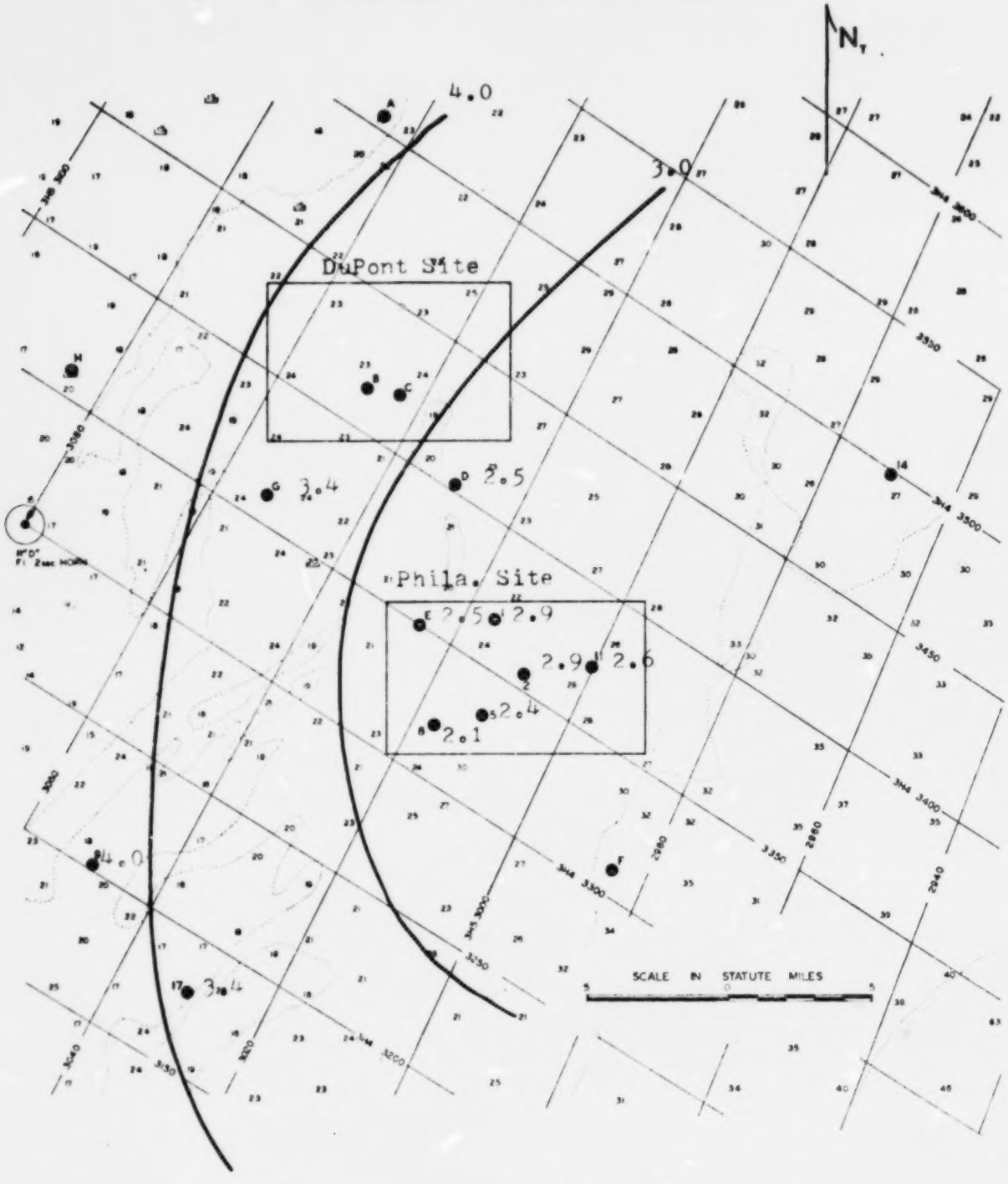


Figure Vanadium Isopleths, 11 Stations

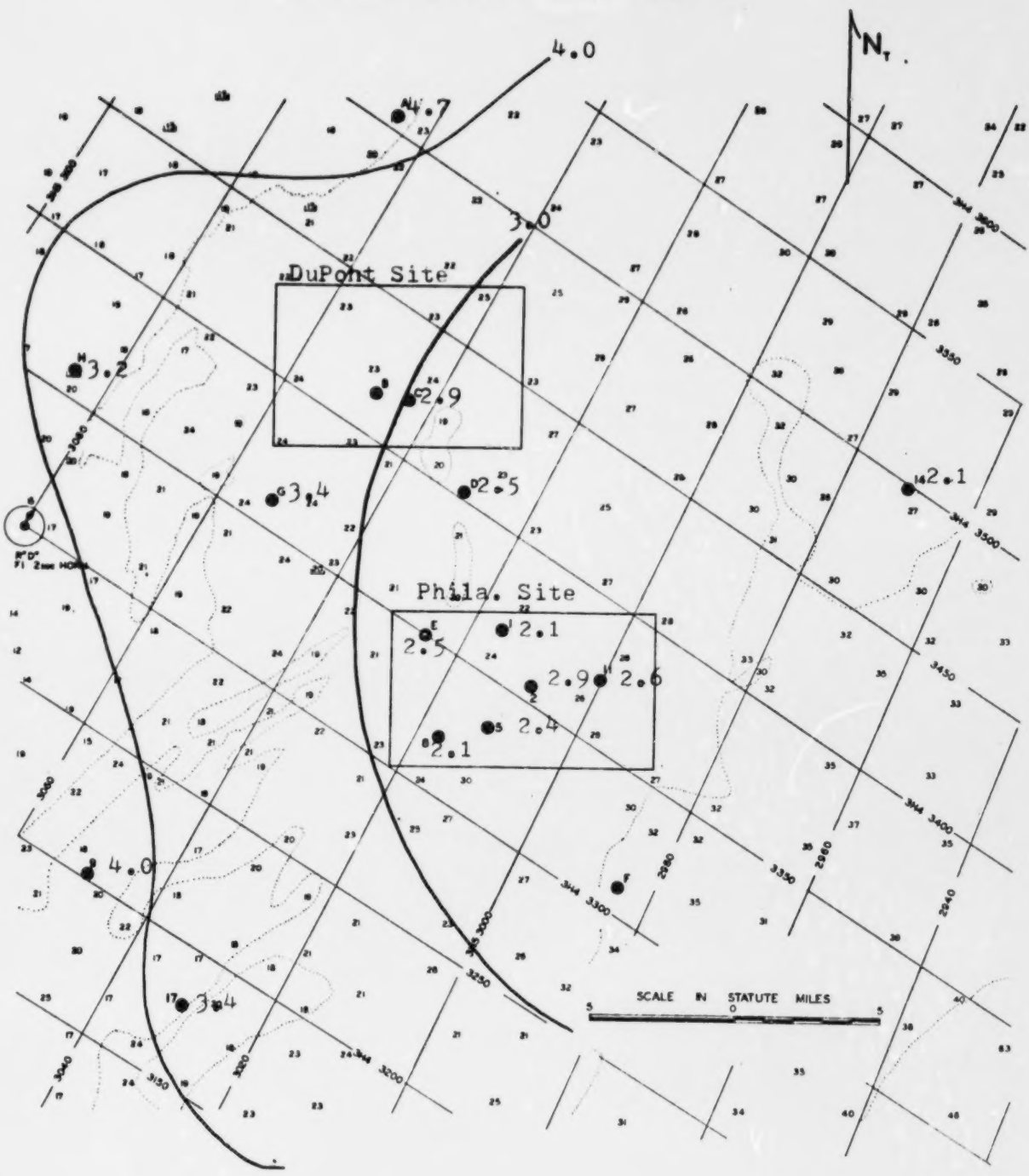


Figure 2 Vanadium Isopleths, 14 Stations

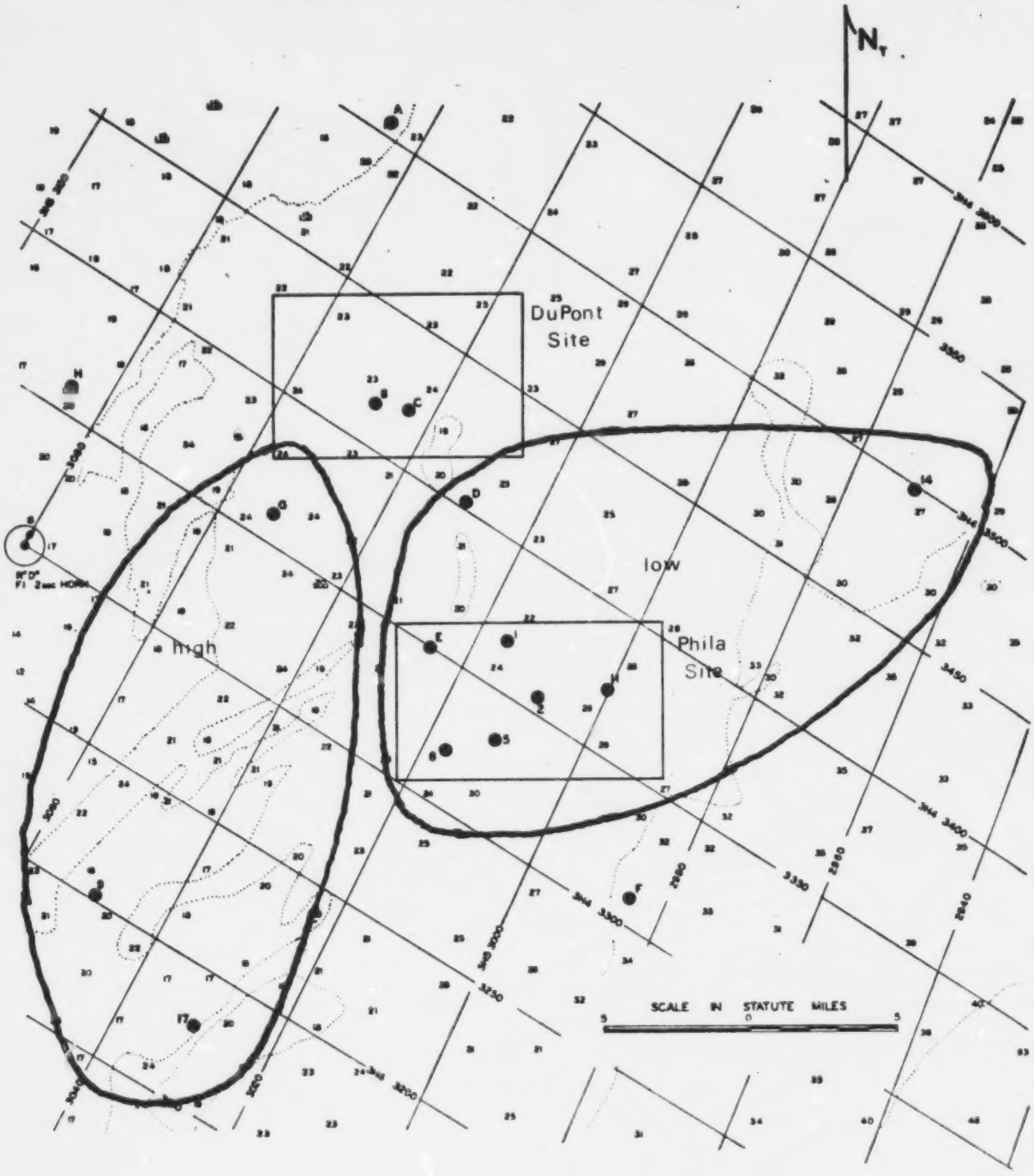


Figure 3 Vanadium Homogeneous Subsets

STATION LOCATIONS

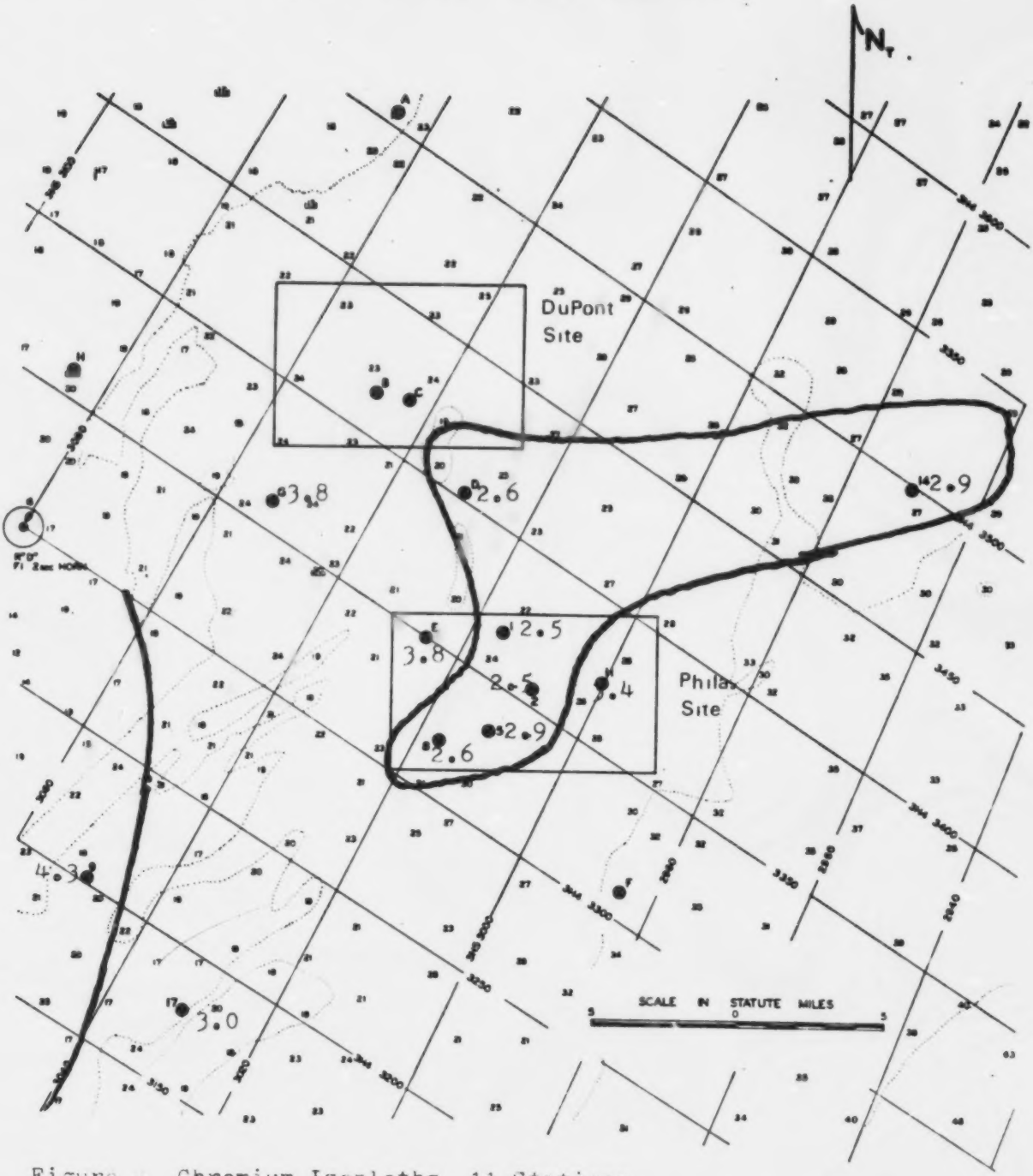


Figure 4 Chromium Isopleths, 11 Stations

STATION LOCATIONS

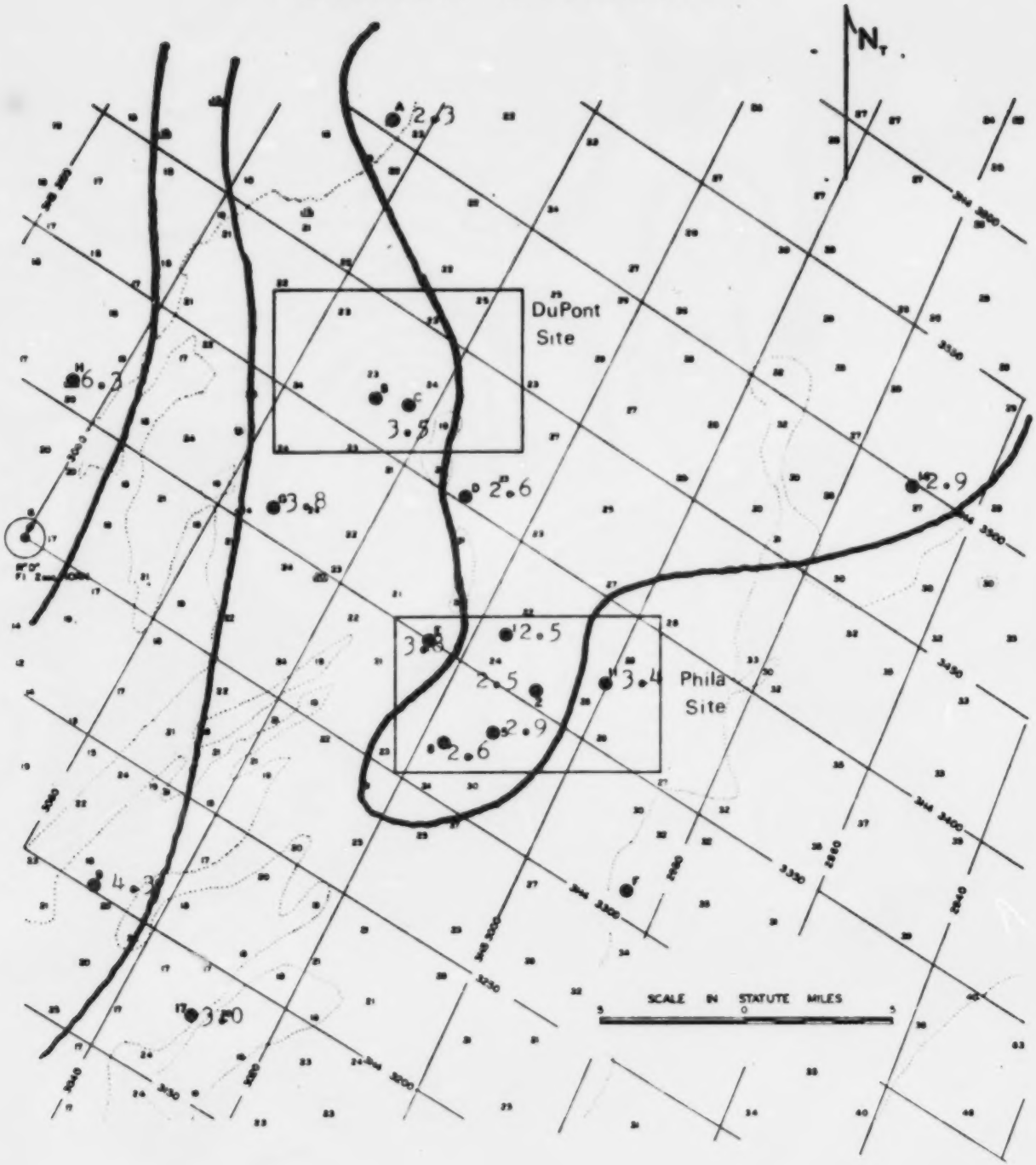


Figure 5 Chromium Isopleths, 14 Stations

STATION LOCATIONS

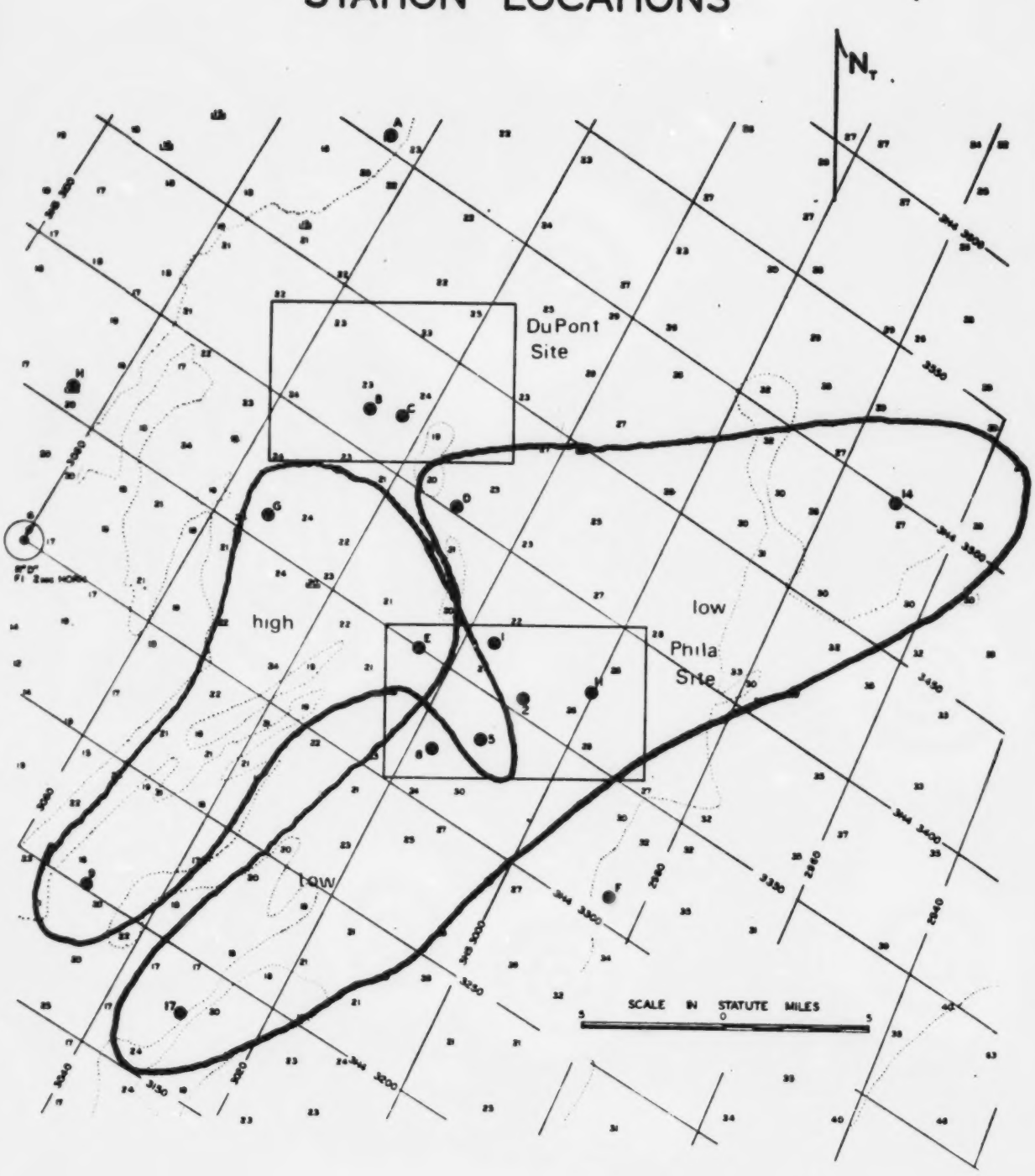


Figure 4 Chromium Homogeneous Subsets

STATION LOCATIONS

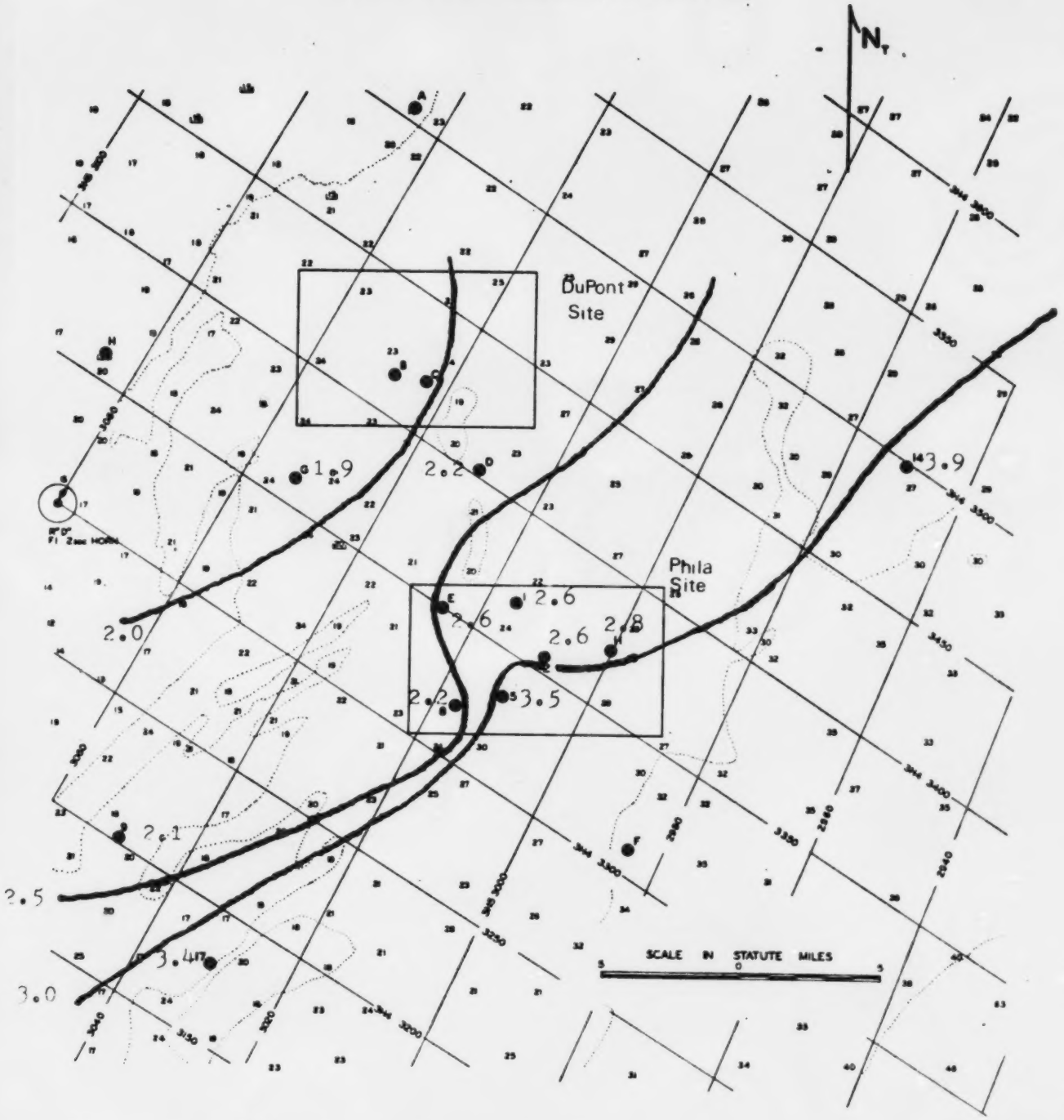
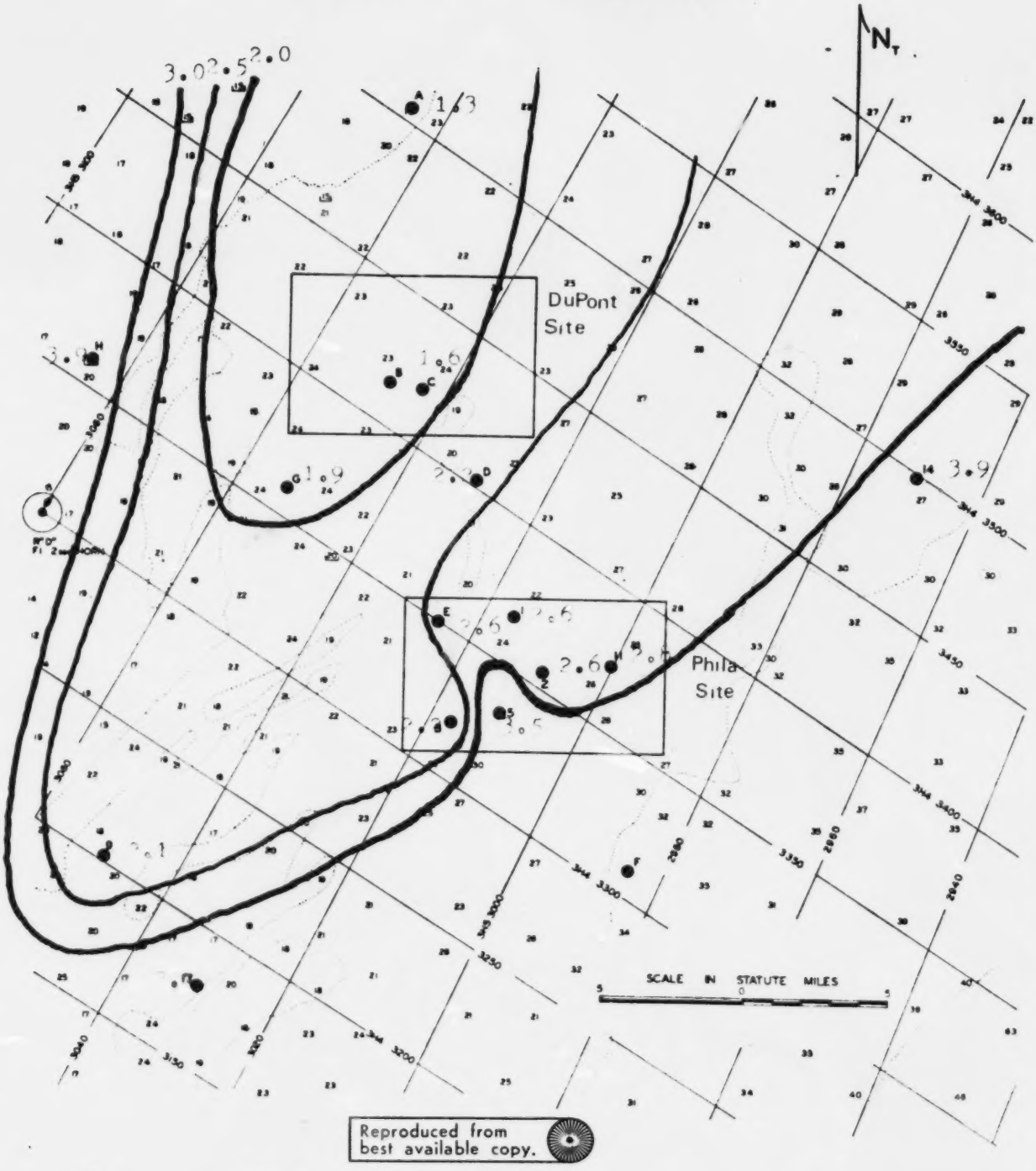


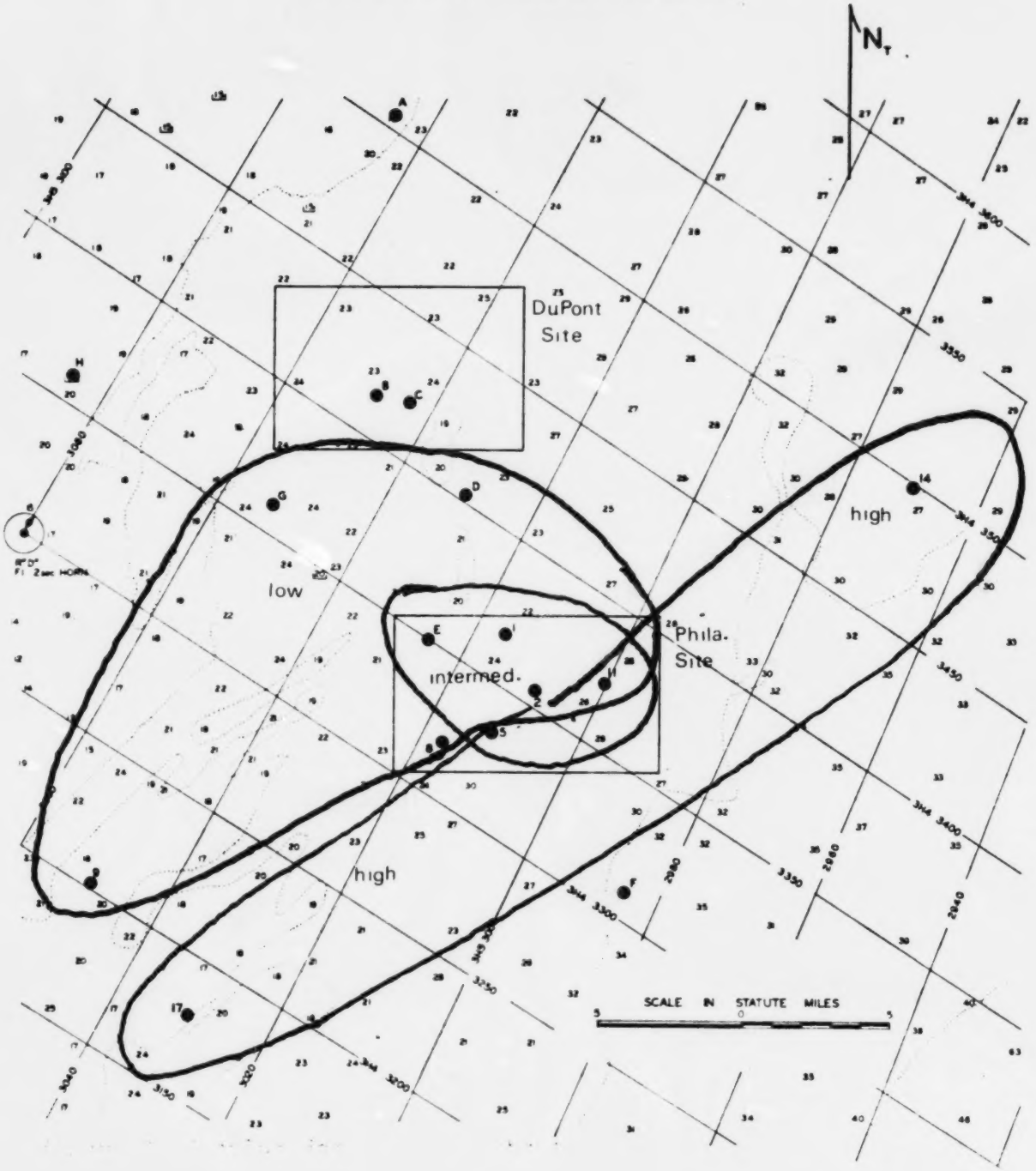
Figure 7 Cadmium Isopleths, 11 Stations

STATION LOCATIONS



Reproduced from best available copy.

STATION LOCATIONS



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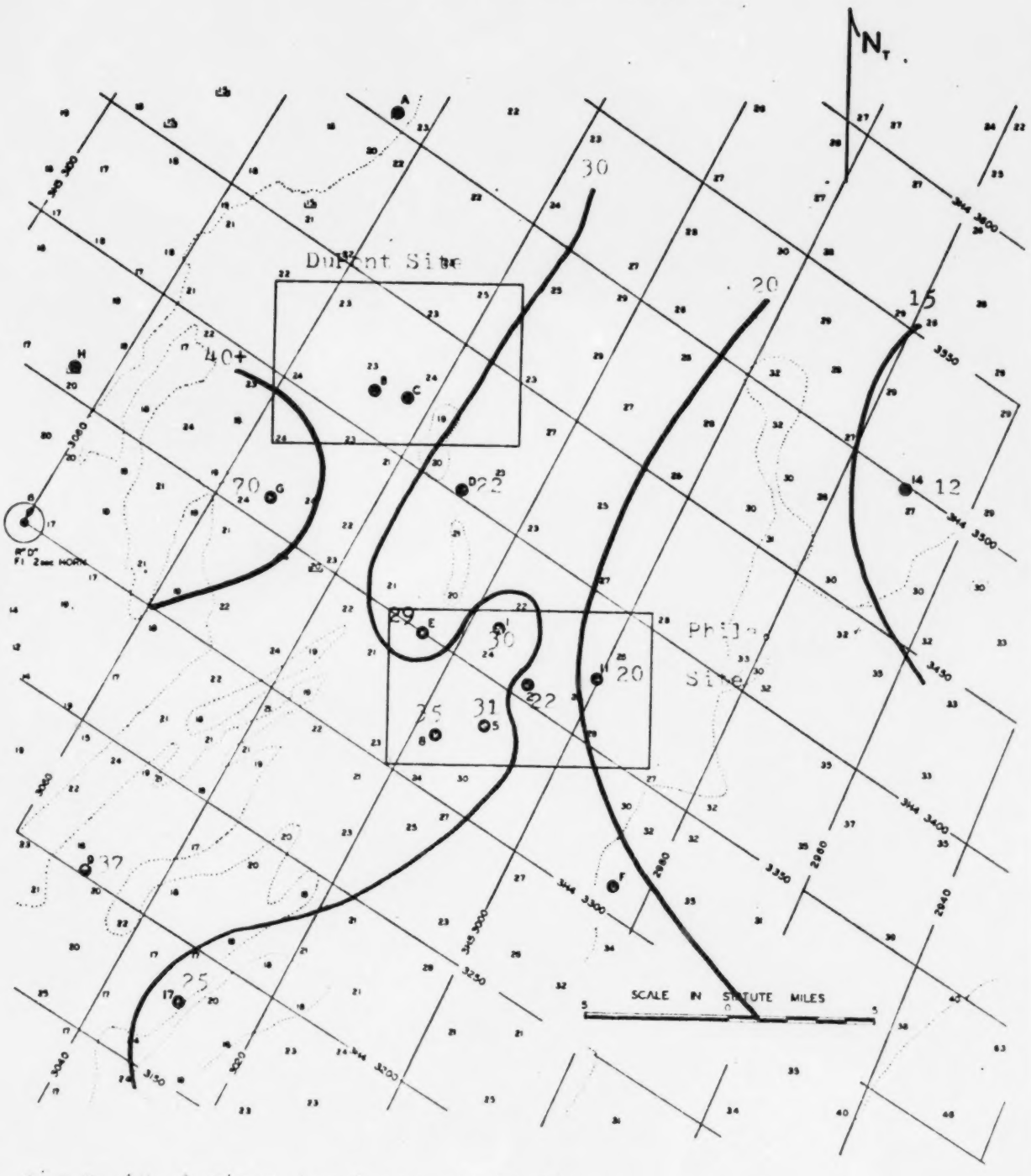

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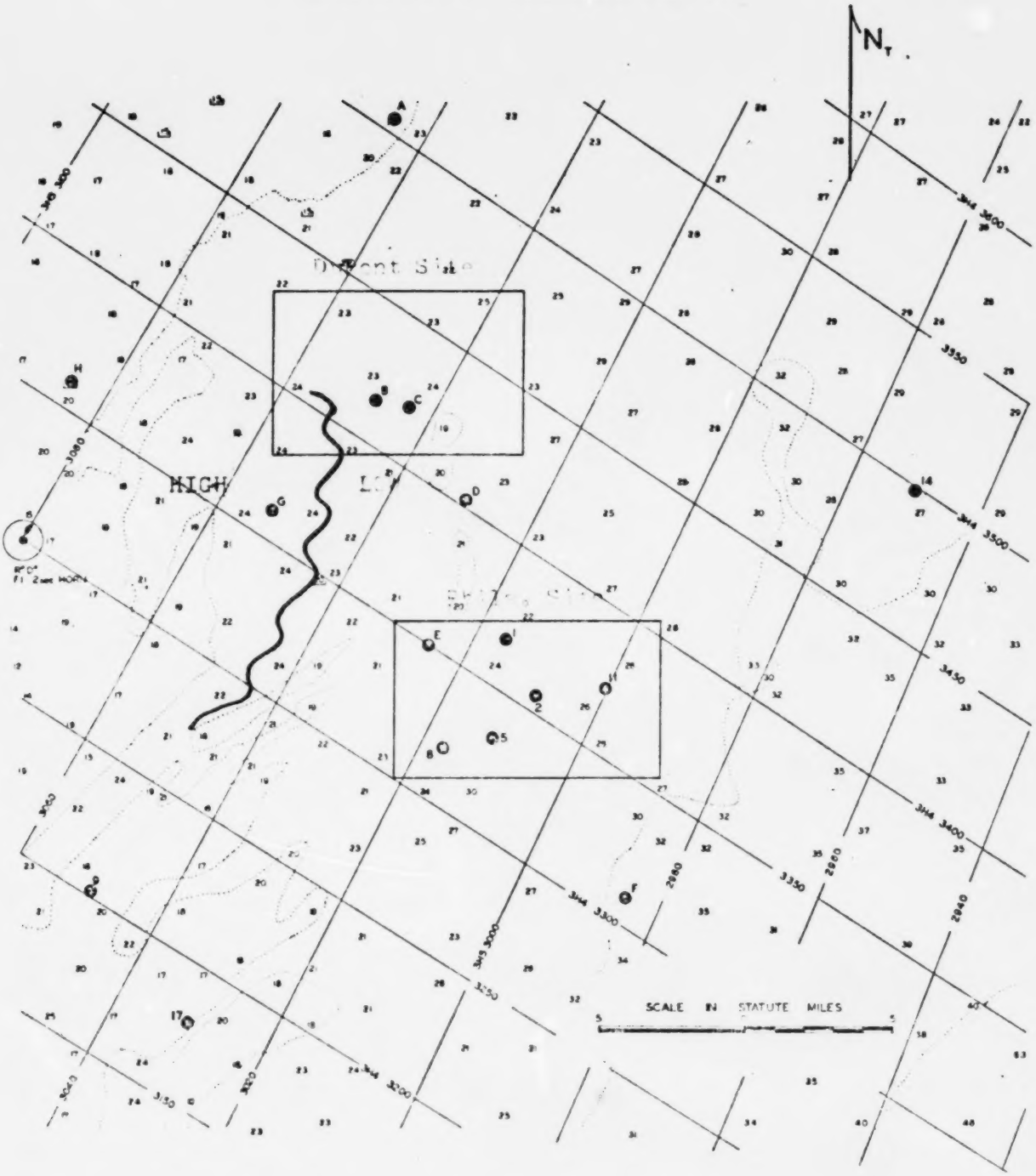
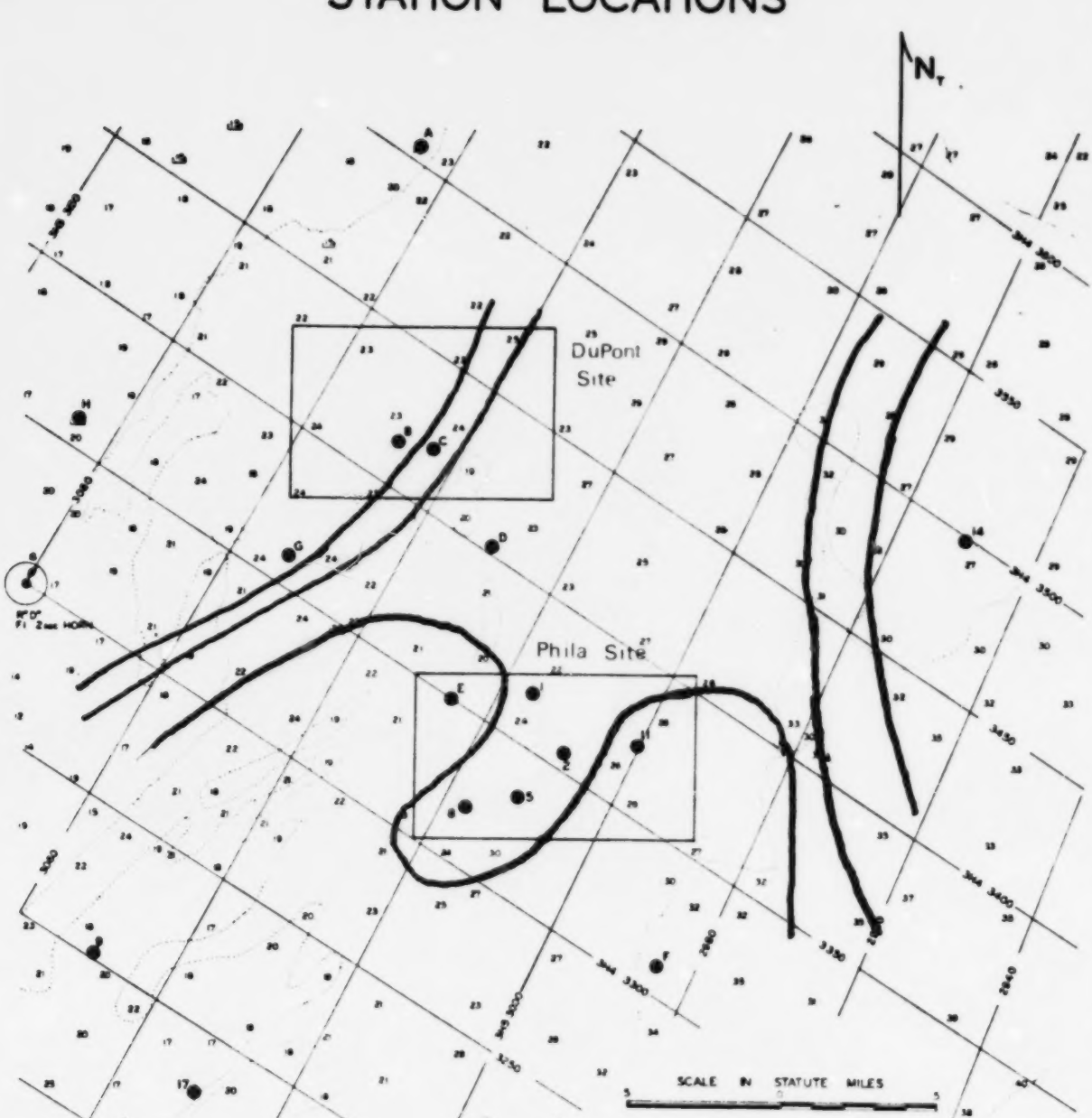


Homogeneo

STATION LOCATIONS



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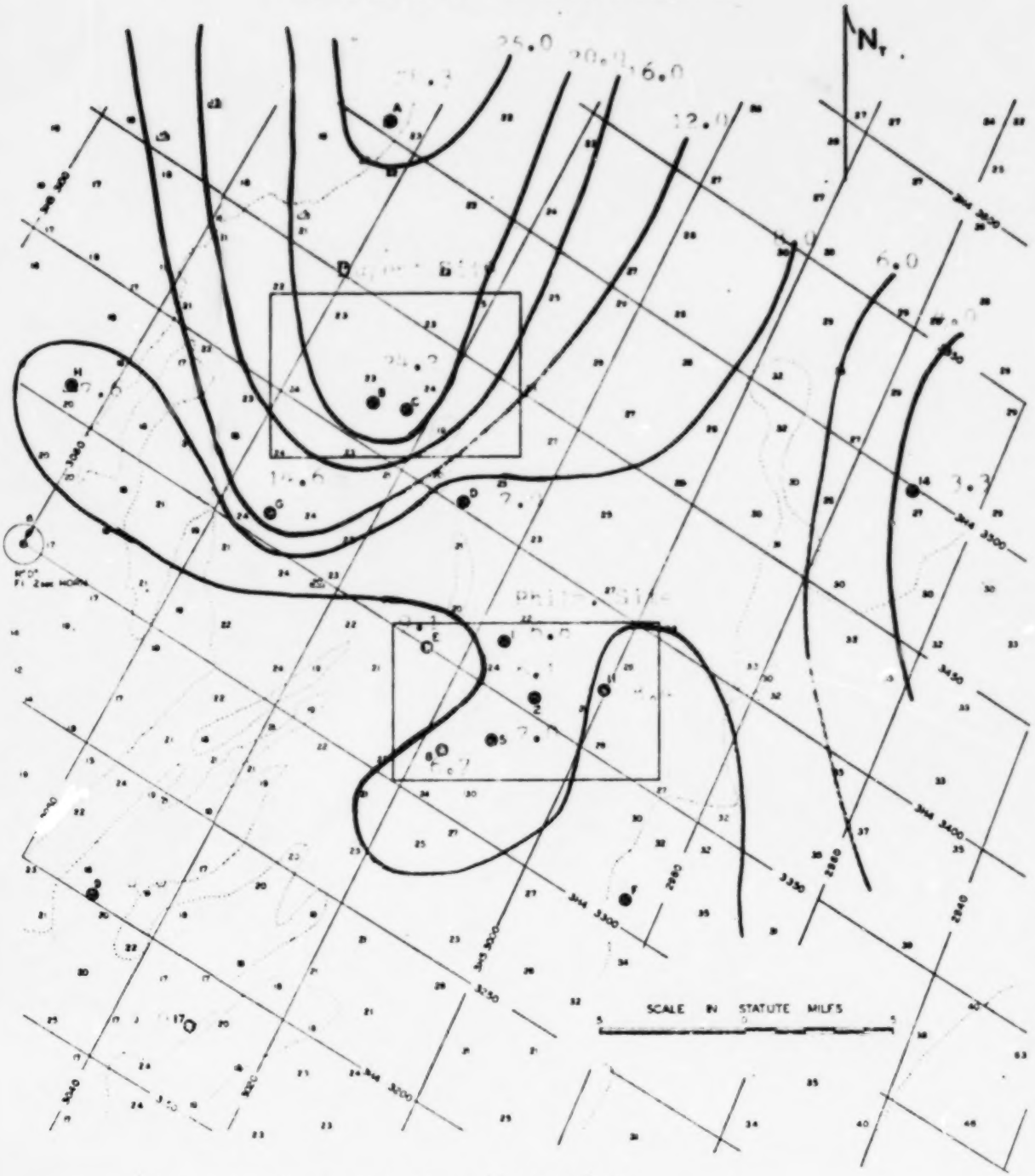

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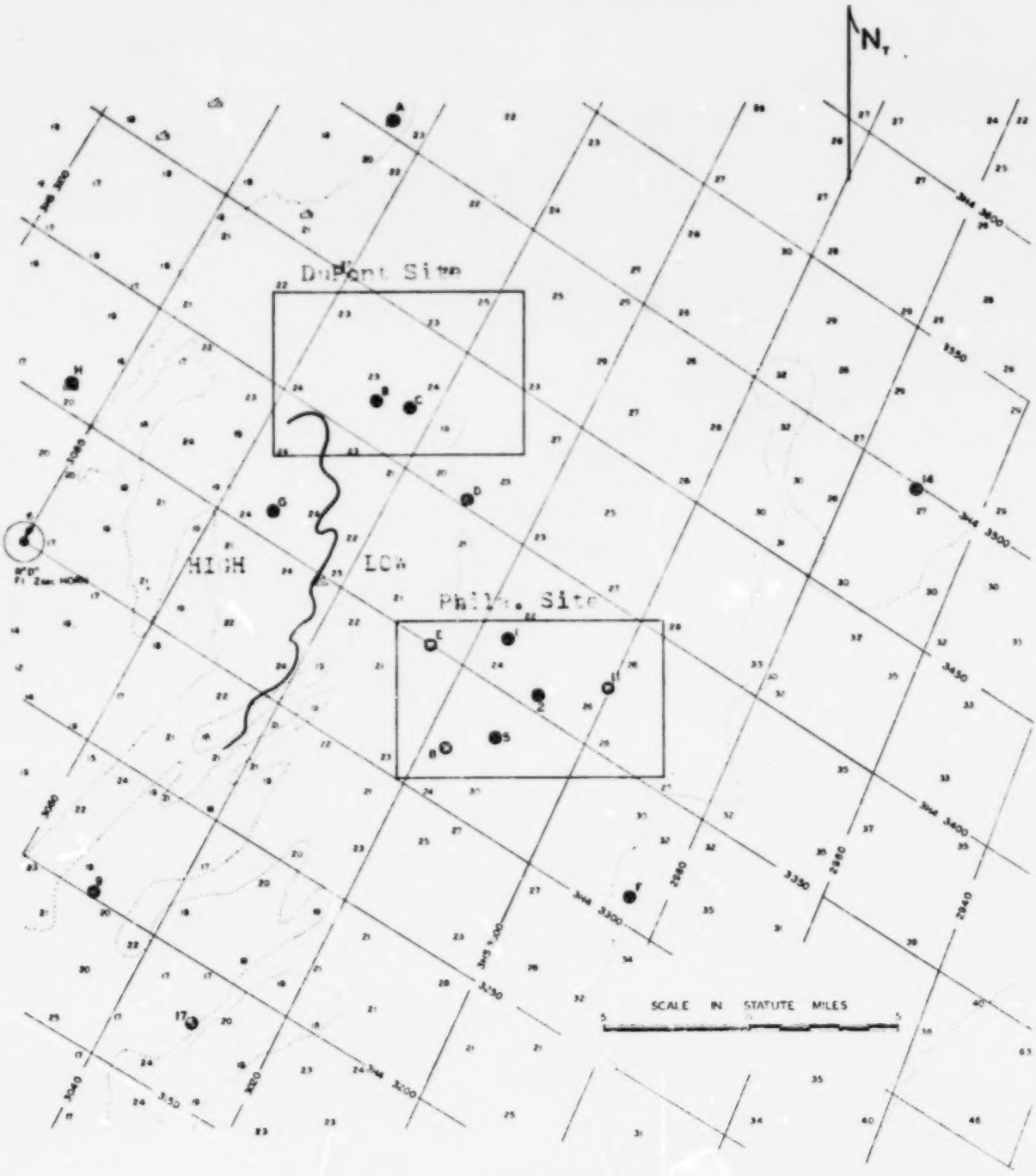

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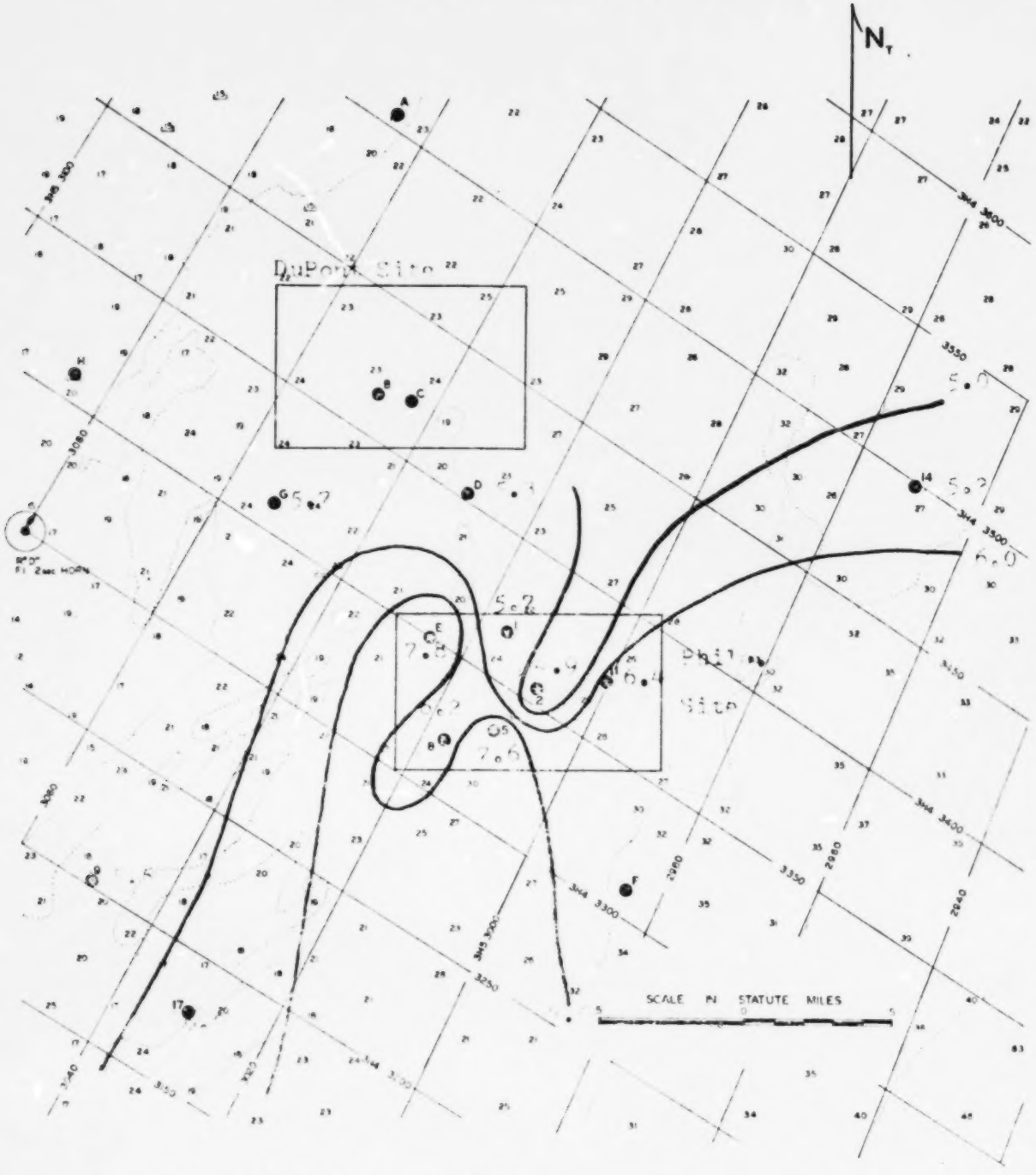

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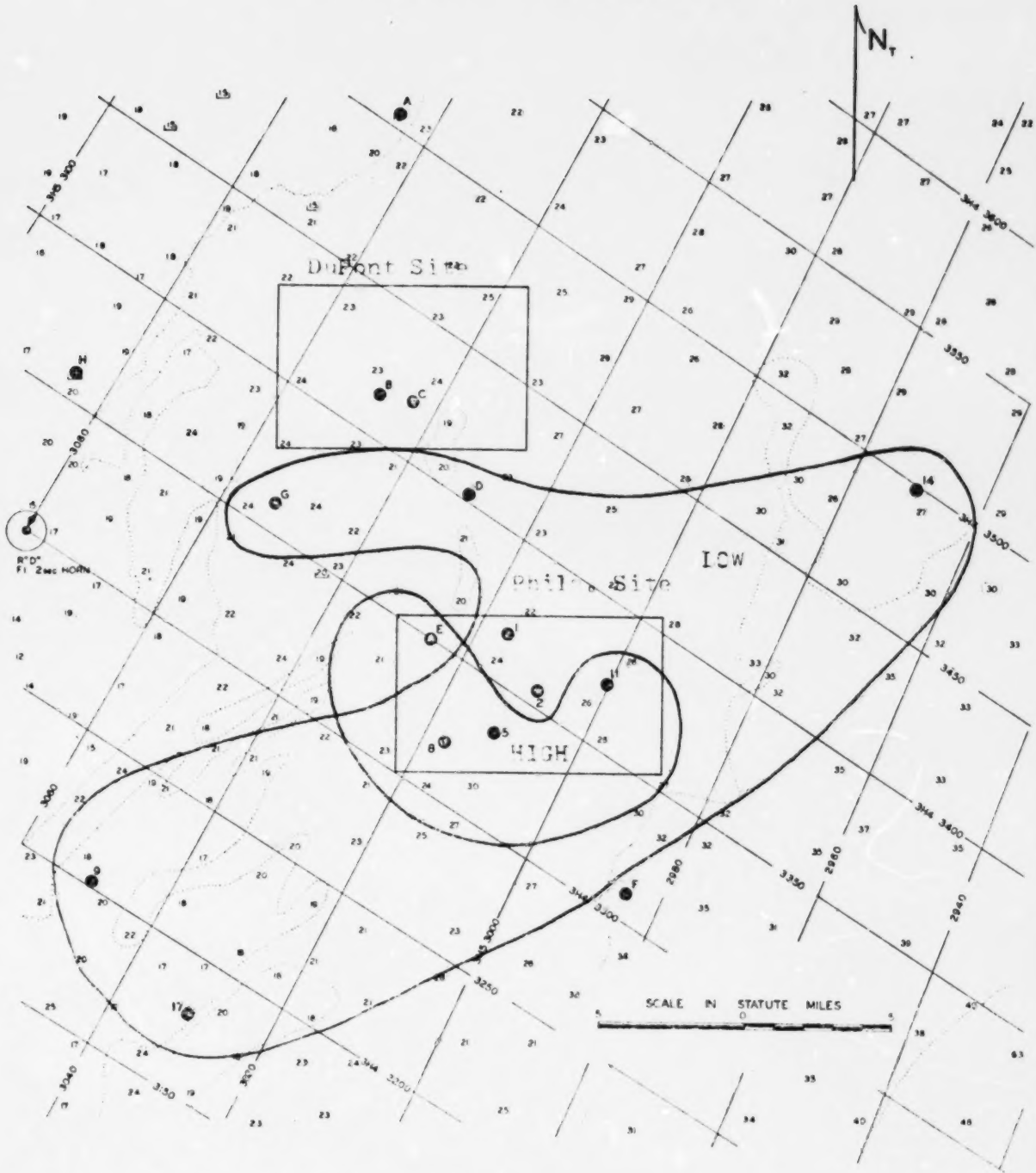

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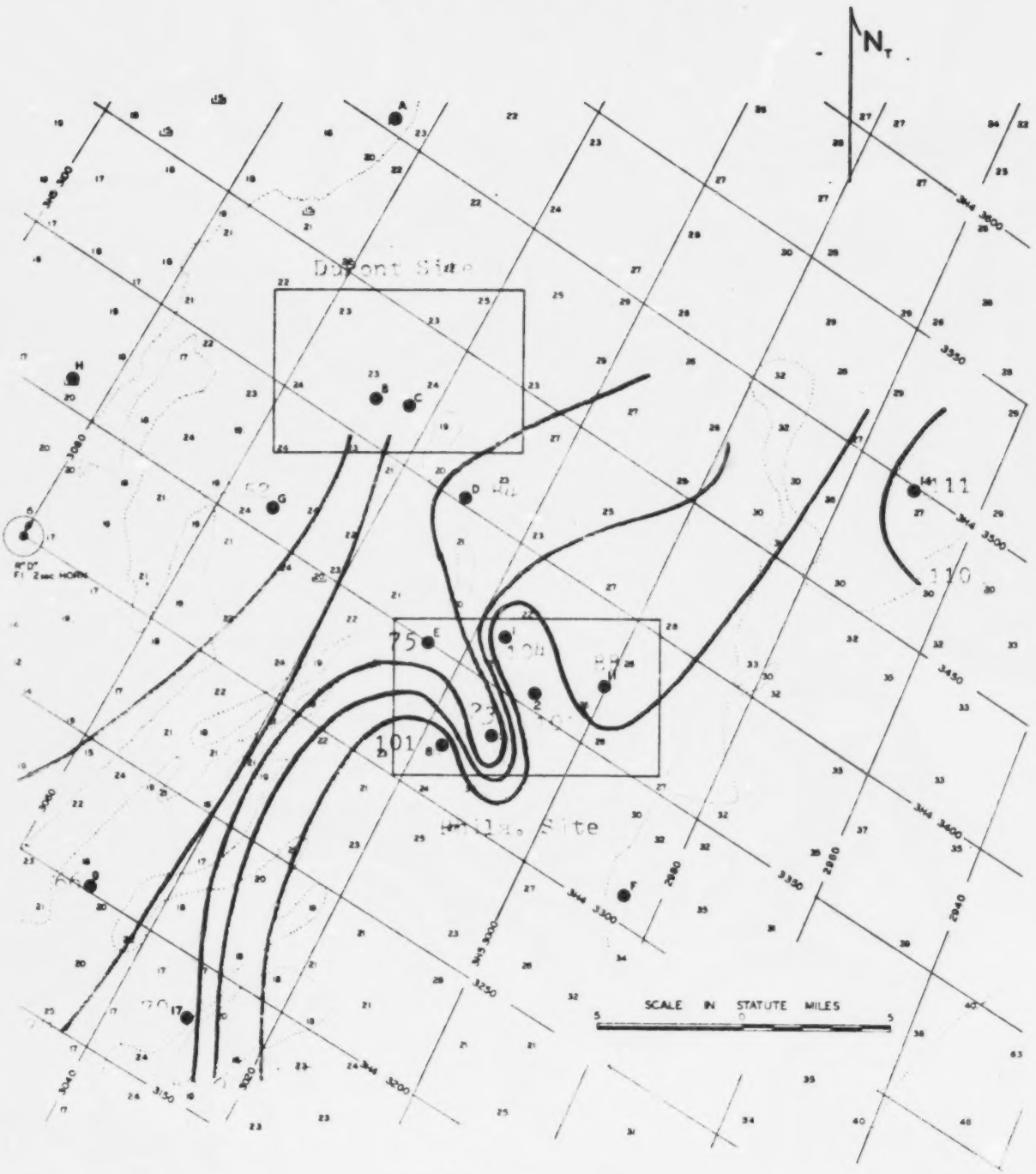

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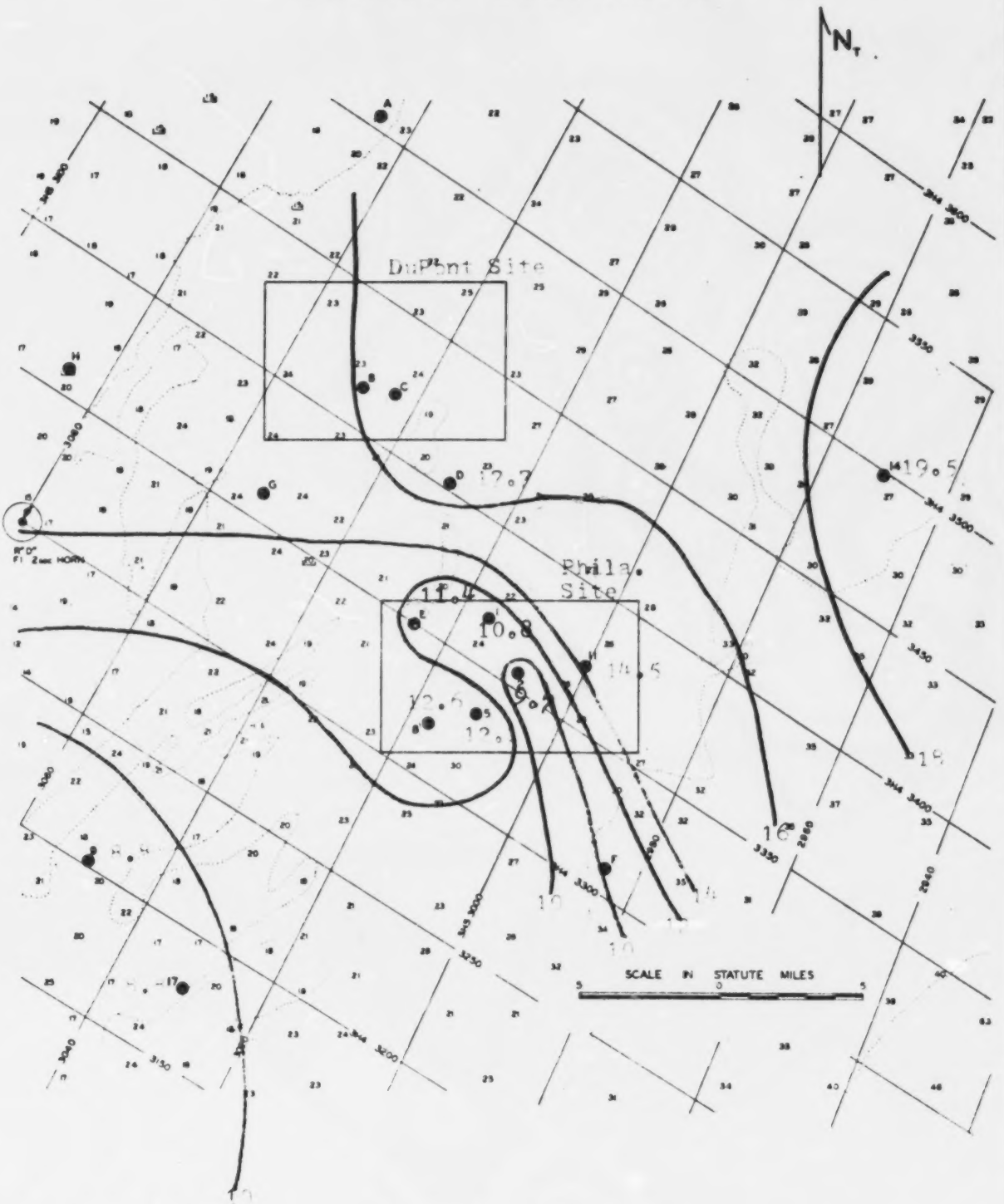
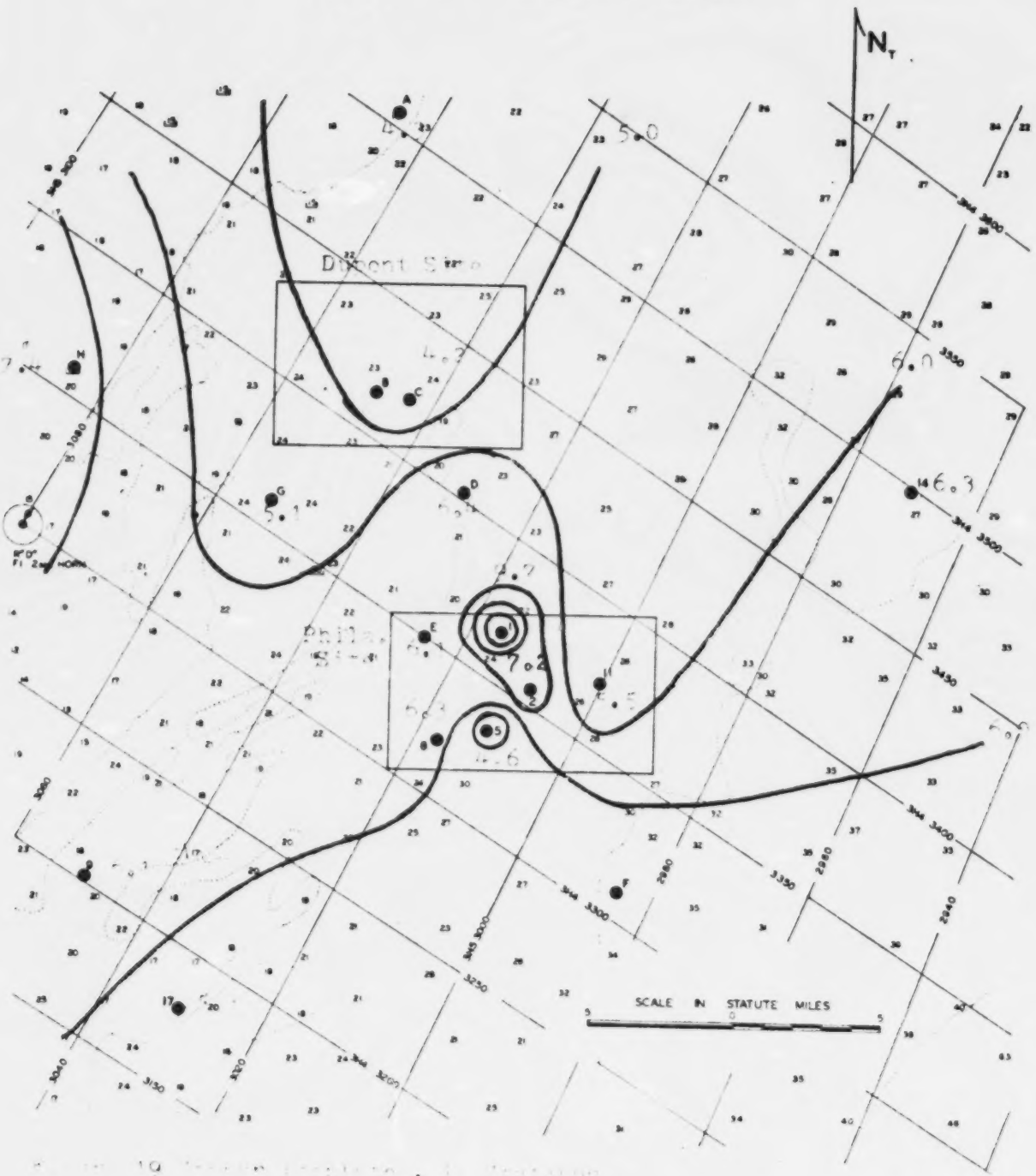


[illegible] 15 Wind Locations, 11 Stations

STATION LOCATIONS



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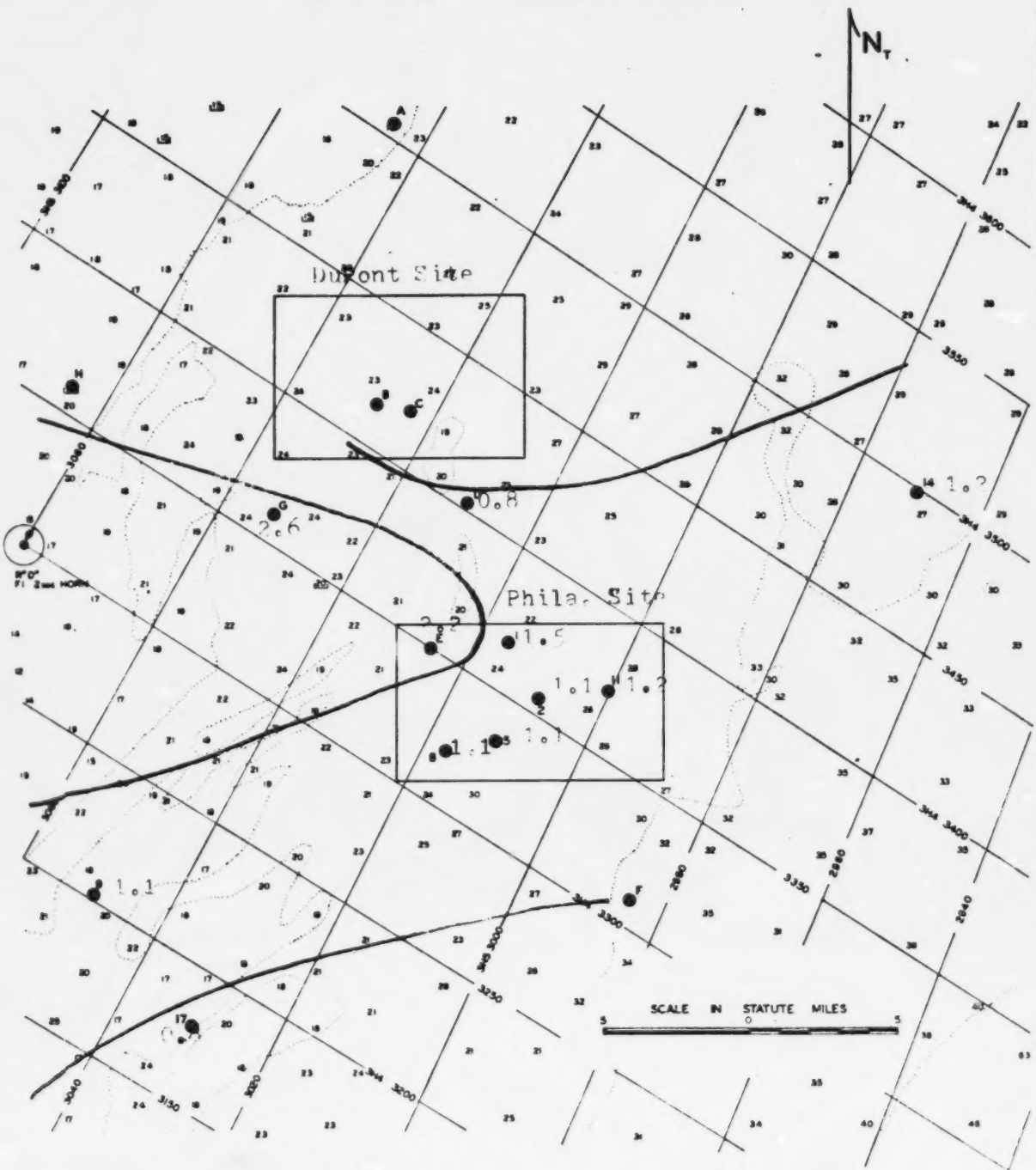
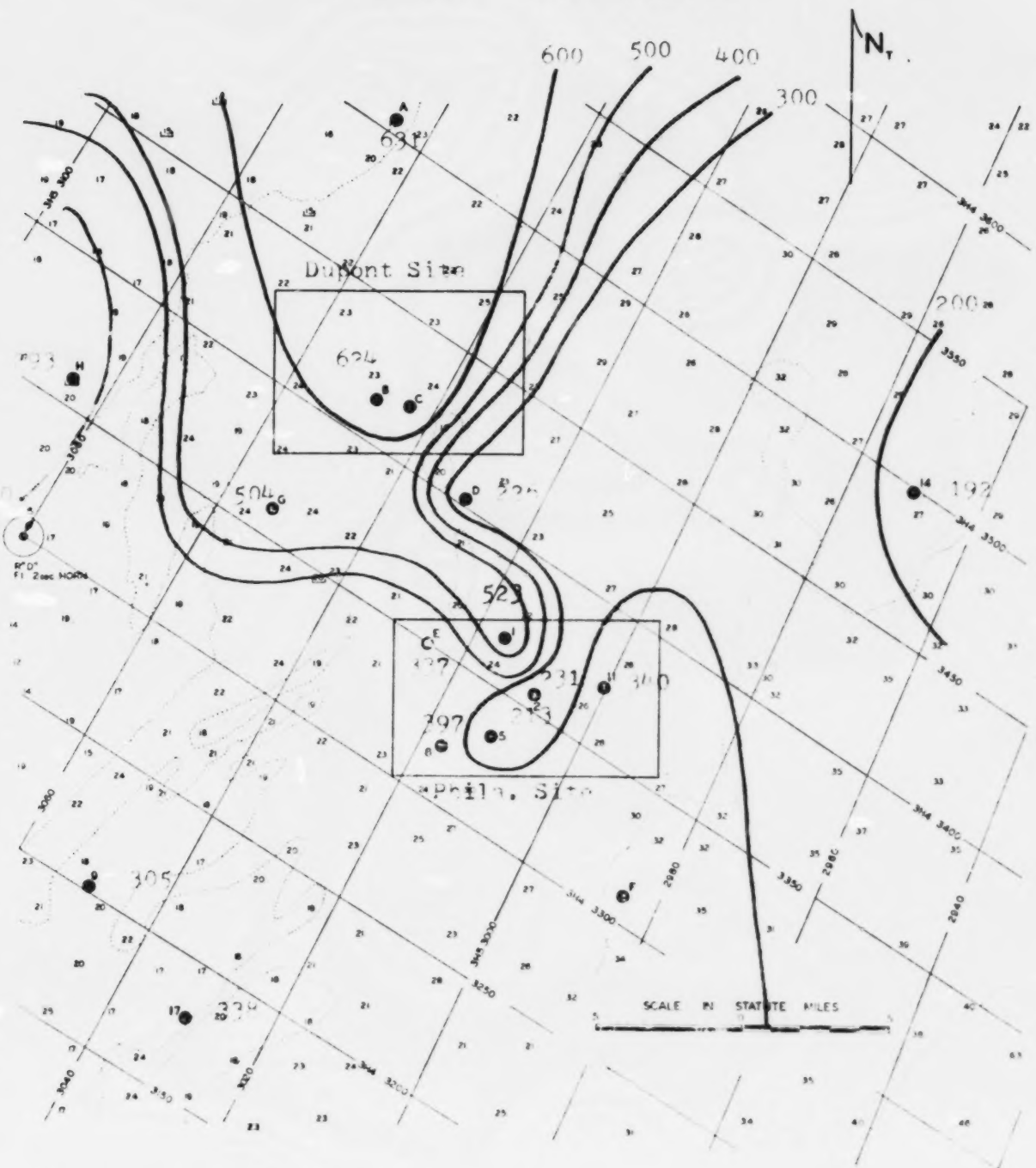


Figure 20 Combit Investigation, 11 Stations

STATION LOCATIONS



STATION LOCATIONS

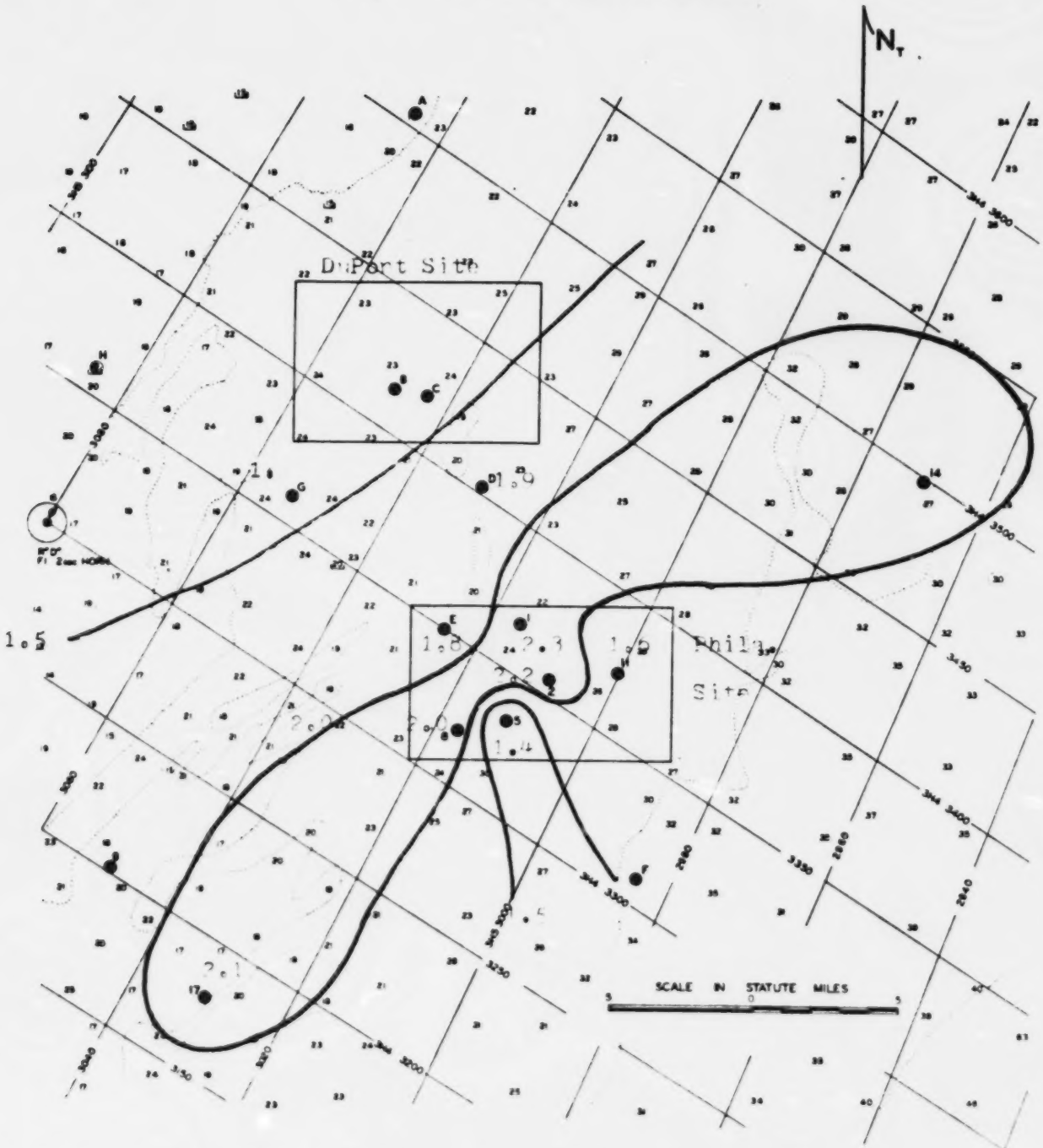


Figure 22 Silver Isopleths, 11 stations

STATION LOCATIONS

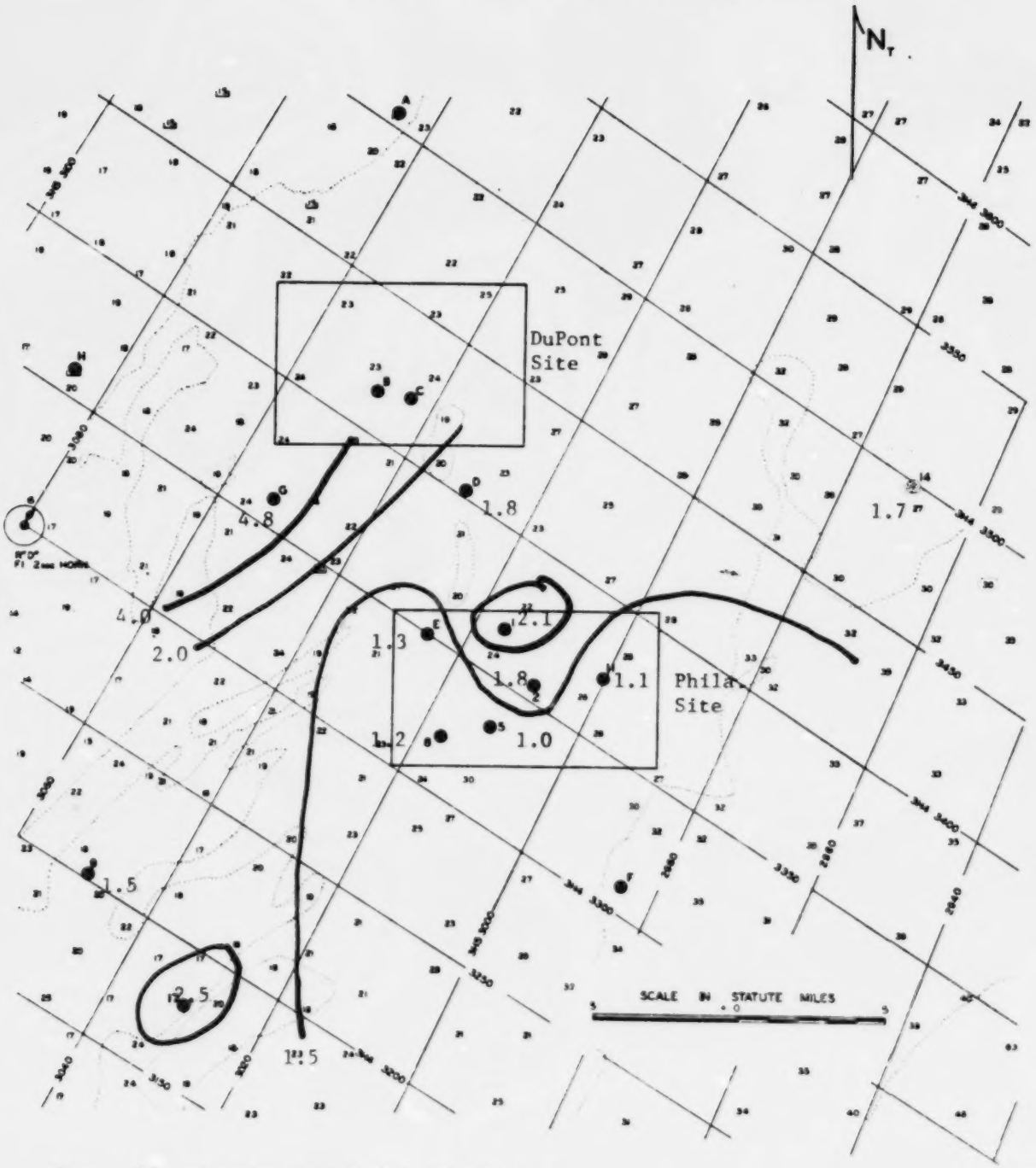


Figure 23 Titanium Isopleths, 11 Stations

STATION LOCATIONS

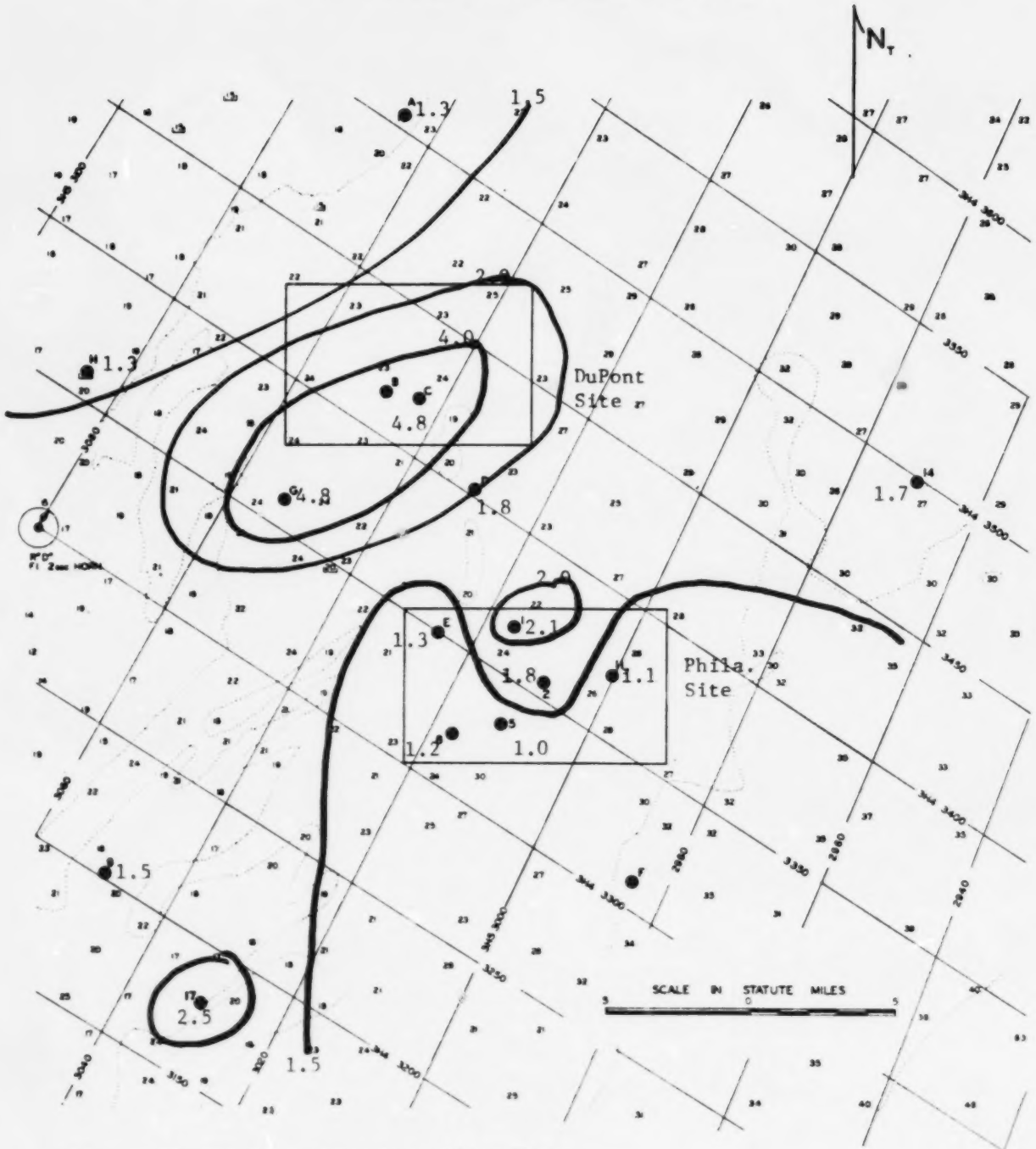


Figure 24 Titanium Isopleths, 14 Stations

STATION LOCATIONS

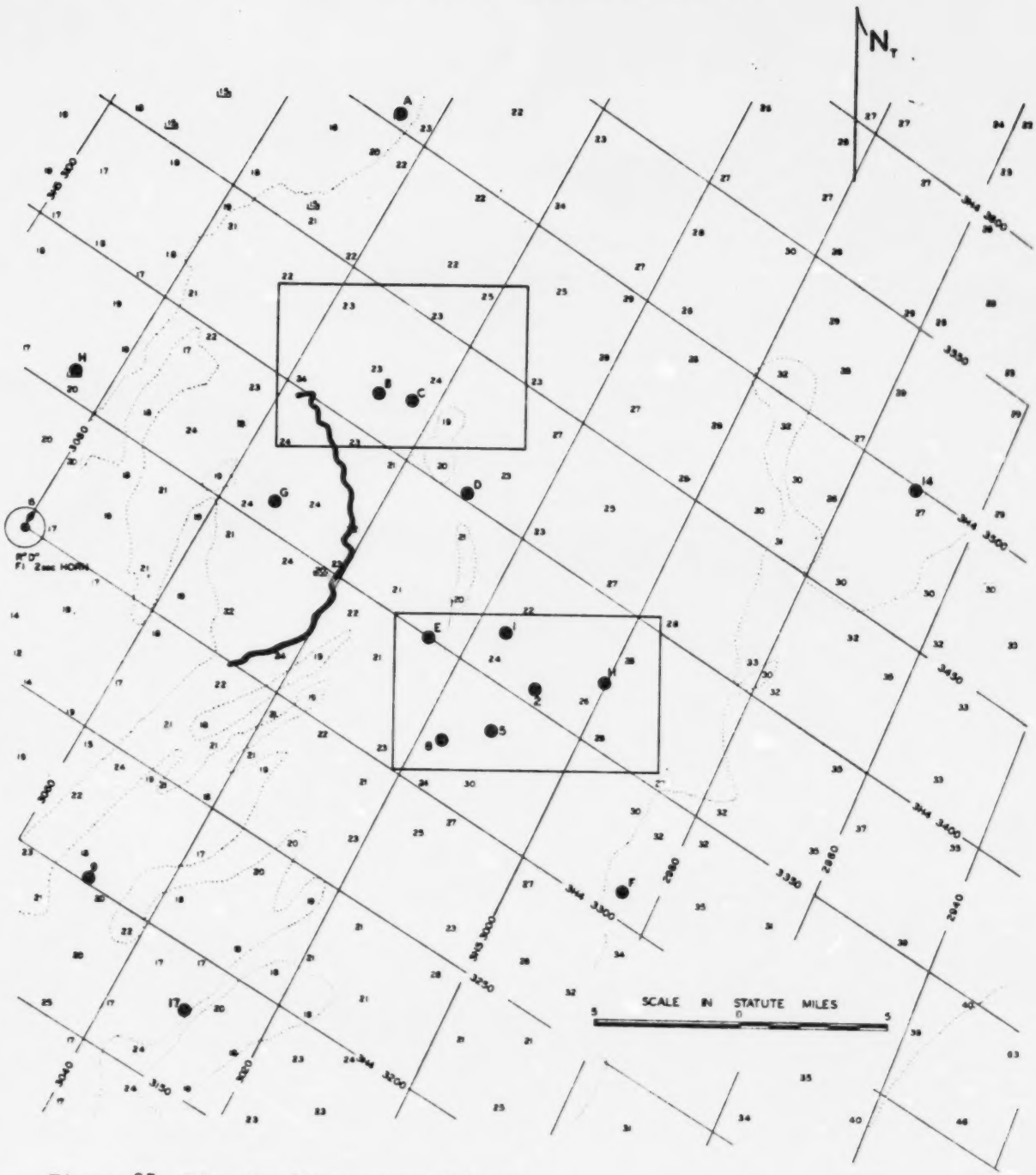


Figure 25 Titanium Homogeneous Subsets

PART IV

ZOOPLANKTON POPULATIONS

Suzanne Sosnowski
U.S. Environmental Protection Agency
National Marine Water Quality Laboratory
Narragansett, Rhode Island

Zooplankton tows were made with paired net hauls, each net measuring 0.5 meter x 0.5 meter, and mesh size of 202μ. Fifteen minute surface tows were made. Samples from tows were split, one for metals analysis (Lear, Smith and O'Malley, 1974) and the remainder for taxonomic characterizations. The latter aliquot was preserved in 5% formalin.

As the primary objective of the cruise was sampling for benthic conditions, plankton tows were given relatively low priority, and few samples taken. Heavy weather forced the utilization of available time for higher priority work.

Methodology

The tows were not quantitatively taken and, as a result, many more animals were in the sample from Station 17 than that of Station 14. For this reason, the Station 17 sample was diluted more before examination than Station 14.

A Folsom Plankton Splitter was used to divide the raw tows. Station 17 sample was split into 1/32 aliquots. One of these aliquots was diluted to 500 ml. The 500 ml dilution was stirred and poured into a 50 ml sampling device which was shaken before a 2 ml sample was taken. This 2 ml sample was counted and keyed out according to genus and species.

Two such 2 ml aliquots were counted. A total approximation of animals in the whole two sample was arrived at by multiplying the number of animals in one 2 ml aliquot by a factor of 8000. The species percent composition was calculated by dividing the number of animals of that species by the total number of animals in the 2 ml aliquot.

The sample from Station 14 was treated in a like manner, except that it was divided into 1/16 aliquots in the Folsom splitter. A total approximation of animals in the whole two sample was arrived at by multiplying the number of animals in one 2 ml aliquot by a factor of 4000. The percent species composition was calculated as above.

Discussion

Station 14: Most frequently occurring species (4%):

Pseudocalanus minutus elongatus - 39.7%

*Temora turbinata (species?) - 32.3%

Centropages typicus - 19.6%

Salps, indicative of warm and/or oceanic waters were found in this sample (Sta. 14).

Station 17: Most frequently occurring species (4%):

Pseudocalanus minutus elongatus - 37.3%

*Temora longicornis (species?) - 19.0%

*Temora turbinata (species?) - 20.1%

Oncaea venusta - 8.0%

Centropages typicus - 4.5%

It appears that Station 17 contained more diverse speciation than Station 14. Pseudocalanus minutus elongatus was dominant in these October surface tows at both stations. The tows were not measured quantitatively when taken, so, although the aliquots were equal from both tows, more animals per aliquot were present in the Station 17 sample. This should not have affected the percent species composition, however.

Grice and Hart (1962), in September oblique tows of these neritic waters (lat 40° 18' x long 71° 28'), found 35 species of copepods of which the most important numerically was Centropages typicus which formed about 50%. Calanus finmarchicus, Candacia armata, Metriclia lucens, Oithona simulis, Paracalanus parvus, and Temora longicornis were also found but none formed more than 6%.

Bigelow and Sears (1939), in October oblique tows of these same shelf waters (out to the 200 meter contour, from lat 41° to lat 36°), found the most important species, numerically, to be Centropages typicus (14%), Paracalanus (12%), Calanus (7%), Pseudocalanus (4%), and Metrichia lucens (2%). The following formed 1% or more or individual stations: 4% Acartia, 7% Candacia armata, 1% Centropages violaceous, 3% Corycaeus, 2% Mecynocera clausi, 11% Oncaea, 1% Pleuromamma gracilis, 6% Scolecithrix danae, 1% Temora longicornis, and 1% Temora stylifera.

Fewer species may have been found in our October tows because they were surface tows, rather than oblique as in the data of Grice and Hart and Bigelow and Sears.

*Reference books were vague on species differentiation for Temora. Both species definitely occurred at Station 17, but the percent may be inaccurate. Some T. longicornis may have gone undetected in Station 14.

TABLE 1

PERCENT ZOOPLANKTON SPECIES COMPOSITION

Two	Species	% of tow
Station 14 Oct. surface	Pseudocalanus minutus elongatus	39.7
	Temora turbinata	32.3
	Centropages typicus	19.6
	*Salps	
Station 17 Oct. surface	Pseudocalanus minutus elongatus	37.3
	Temora turbinata	20.1
	Temora longicornis	19.0
	Oncaea venusta	8.0
	Centropages typicus	4.5
Grice & Hart Sept. oblique	Centropages typicus	50.0
Bigelow & Sears Oct. oblique	Centropages typicus	14.0
	Paracalanus	12.0
	Calanus	7.0
	Pseudocalanus	4.0
	Metridia lucens	2.0

* Salps are indicative of warm and/or oceanic waters. There were none in Station 17 sample.

REFERENCES

American Public Health Association. Standard Methods for the Examination of Water and Wastewater. APHA 13th Ed. 864 pp. 1971.

Beeton, A. M. Environmental changes in Lake Erie. Transactions of the American Fisheries Society 90:153-159. 1961.

Bigelow, H. B. and M. Sears. Studies of the waters of the Continental Shelf, Cape Cod to Chesapeake Bay. Contrib. No. 194. Woods Hole Oceanographic Institution. Memoirs of the Museum of Comparative Zoology at Harvard College, Cambridge. Vol. IV, No. 4:179-378. 1939.

Butcher, R. W. The biological detection of pollution. Journal of the Institute of Sewage Purification 2:92-97. 1946.

Champ, Michael A. Organic and inorganic carbon cycles in a pond ecosystem. Ph.D. Dissertation, Texas A&M University. 1973.

Champ, Michael A. Operation SAMS, Sludge Acid Monitoring Survey, American University, Ceres Program Publication No. 1. 1974.

Florida Ocean Sciences Institute. Limitations and effects of waste disposal on an ocean shelf. EPA-16070EFG12/71. 304 pp. 1971.

Fredericks, A. D. and W. M. Sackett. Organic carbon in the Gulf of Mexico. J. of Geophysical Res. 75:2199-2206.

Freund, John E. Modern Elementary Statistics. Prentice Hall, Inc. New Jersey. 1973.

Gordon, D. C., Jr. Some studies on the distribution and composition of particulate organic carbon in the North Atlantic Ocean. Deep-Sea Res. 17:233-243. 1967.

Grice, G. D. and A. Hart. The abundance, seasonal occurrence and distribution of the epizooplankton between New York and Bermuda. Contrib. No. 1237, Woods Hole Oceanographic Institution, pp 287-307. 1962.

Hobson, L. A. The seasonal and vertical distribution of suspended particulate matter in an area of the northeast Pacific Ocean. Oceanography 11:510-519. 1967.

Hobson, L. A., D. W. Menzel, R. T. Barber. Primary productivity and sizes of pools of organic carbon in the mixed layer of the ocean. Marine Biology 19:298-306. 1973.

Hynes, H. B. N. The Biology of Polluted Waters. Liverpool University Press, Liverpool xiv + 202 pp. 1960.

Izzo, Leonard A. Dissolved and Particulate Biological Iron. In Champ (Editor Operation SAMS: Sewage Acid Monitoring Survey. The American University Ceres Publication No. 1. 169 pp. 1974.

Lear, D. W., S. K. Smith and M. L. O'Malley (Eds.) Environmental Survey of Two Interim Dumpsites, Middle Atlantic Bight - Operation "Fetch" EPA 903/9-74-010a. 141 pp. 1974.

Menzel, D. W. Particulate organic carbon in the deep sea. Deep-Sea Res. 14:229-238. 1967.

Menzel, D. W. and J. J. Goering. The distribution of organic detritus in the ocean. Limnology and Oceanography 11:333-337. 1966.

Menzel, D. W. and R. F. Vaccaro. The measurement of dissolved organic and particulate carbon in sea water. Limn. Ocean. 9:138-142. 1964.

Owre, H. B. and M. Foyo. Copepods of the Florida current. Fauna Caribaea, No. 1, Crustacea, Part i: Copepoda. Institute of Marine Science, Miami. p 137. 1967.

Palmer, H. D. and D. W. Lear (Eds.) Environmental Survey of an Interim Ocean Dumpsite, Middle Atlantic Bight - Operation "Quicksilver" EPA 903/9-001-A. 132 pp. 1973.

Rose, M. Faune de France. Copepodes Pelagiques. Kraus Repring. Nendeln. 374 pp. 1970.

Strickland, J. D. H. and T. R. Parsons. A Practical Handbook of Seawater Analysis. Bull. No. 167 Fisheries Research Board of Canada, Ottawa. 1972.

Szekielda, K. H. Some remarks on the influence of hydrographic conditions on the concentration of particulate carbon in seawater. In: Proceedings of an I.B.P. symposium, pp 314-322. Ed. by H. L. Golterman and R. S. Clymo. Amsterdam: N.V. Noord-Hollandsche Vitgevers Maatschappiji. 1967.

Wangersky, P. J. and D. C. Gordon, Jr. Particulate carbonate, organic carbon and Mn^{++} in the open ocean. Limn. Ocean. 10:544-440. 1965.

Williams, P. M. The distribution and cycling or organic matter in the oceans. Organic Compounds in Aquatic Environments. Samuel D. Faust and Joseph V. Hunter, Eds. 7:145-163. Mariel Dekker, Inc., New York. 1971.

Wilson, C. The copepods of the Woods Hole region. Smithsonian Institution, U. S. National Museum Bulletin No. 158. 635 pp. U. S. Government Printing Office, Washington. 1932.

Wilhm, J. L. and T. C. Dorris. Biological parameters for water quality criteria. Bioscience 18:477-481.

APPENDIX 1

Metals Concentrations in Echinoderm and Mollusc Tissues

Arctica — µgm/gm Wet Weight

		14	9	17	1	2	5	8	11
Fe	Mean	20.31	33.47	44.67	59.00	29.31	24.73	43.73	32.95
	Range	10.01-28.17	20.15-49.20	14.81-95.15	10.69-310.92	14.18-62.45	17.36-29.76	17.09-108.05	22.38-64.30
	# Samples	3	10	8	12	4	3	5	6
Cu	Mean	0.65	0.75	0.10	1.09	0.85	0.73	.073	0.54
	Range	0.44-0.94	0.36-1.12	0.48-0.95	0.42-3.37	0.39-1.38	0.57-0.90	0.37-0.86	0.38-0.72
	# Samples	3	10	8	12	4	3	5	6
Zn	Mean	11.56	8.04	9.13	11.03	11.20	8.56	11.51	8.55
	Range	6.80-17.56	5.54-10.93	6.29-11.68	5.62-34.39	7.82-16.34	5.71-11.13	5.96-16.80	3.76-12.63
	# Samples	3	10	8	12	4	3	5	6
Cd	Mean	0.413	0.263	0.443	0.316	0.303	0.398	0.254	0.268
	Range	0.284-0.616	0.174-0.402	0.220-0.731	0.141-0.726	0.229-0.441	0.212-0.526	0.134-0.329	0.166-0.414
	# Samples	3	9	8	11	4	3	5	6
Ag	Mean	0.24	0.24	32.23	0.24	0.24	0.16	0.23	0.16
	Range	0.12-0.42	0.10-0.39	0.17-256.0	0.11-0.79	0.14-0.39	0.10-0.23	0.09-0.65	0.09-0.26
	# Samples	3	10	8	12	4	3	5	6
Mn	Mean	0.25	1.03	1.18	6.89	0.75	0.82	0.78	0.74
	Range	0.03-0.39	0.54-1.74	0.91-1.90	0.34-72.83	0.31-1.54	0.58-1.28	0.56-1.21	0.16-1.71
	# Samples	3	10	8	12	4	3	5	6
Pb	Mean	0.54	1.11	0.76	1.18	0.56	0.88	0.51	0.62
	Range	0.34-0.65	0.36-5.17	0.67-0.91	0.51-9.00	0.37-0.74	0.59-1.18	0.03-0.87	0.40-0.85
	# Samples	3	10	8	12	4	3	5	6
Co	Mean	0.16	0.14	0.10	0.17	0.11	1.2	0.13	0.12
	Range	0.09-0.23	0.09-0.18	0.08-0.13	0.06-0.43	0.09-0.18	0.08-0.15	0.06-0.22	0.08-0.20
	# Samples	3	10	8	12	4	3	5	6
Ni	Mean	2.00	1.07	1.14	1.40	1.04	1.42	1.50	1.43
	Range	1.17-2.79	0.599-1.85	0.68-2.07	0.08-1.77	0.63-1.51	0.584-1.99	0.674-2.725	0.894-2.23
	# Samples	3	10	8	12	4	3	5	6
Cr	Mean	3.01	0.533	0.448	0.347	0.286	0.392	0.304	0.326
	Range	0.196-0.428	0.376-0.839	0.277-0.595	0.173-0.585	0.234-0.346	0.30-0.474	0.16-0.414	0.20-0.43
	# Samples	3	10	8	12	4	3	5	6
Al	Mean	1.13	4.46	3.26	3.13	2.20	3.61	4.18	1.92
	Range	0.262-1.58	1.79-10.83	2.06-6.86	1.75-5.76	1.71-2.56	2.35-5.27	1.33-9.99	1.25-2.45
	# Samples	3	10	7	11	3	3	5	6
V	Mean	0.217	0.487	0.442	0.339	0.329	0.274	0.247	0.247
	Range	0.167-0.261	0.379-0.728	0.255-0.585	0.266-0.655	0.257-0.433	0.148-0.377	0.176-0.409	0.213-0.303
	# Samples	3	10	8	12	4	3	5	6

Metals Concentrations in Echinoderm and Mollusc Tissues

Arctica

µgm/gm Wet Weight

		E	C	D	G	B	A	H
Fe	Mean	39.60	153.15	25.54	113.55		148.37	30.69
	Range	12 19-	--	5.11-	21.23-		--	--
		73.72	--	45.18	389.74		--	--
	# Samples	10	1	6	8		1	1
Cu	Mean	0.67	1.01	0.72	0.90		1.01	0.770
	Range	0.45		0.52	0.58		--	--
		1.02		1.14	1.24		--	--
	# Samples	10	1	6	8		1	1
Zn	Mean	8.14	9.571	9.44	9.10		9.719	14.781
	Range	4.29		7.15	4.72		--	--
		12.22	--	12.99	13 21		--	--
	# Samples	10	1	6	8		1	1
Cd	Mean	0·2789	0.404	0.250	0.340		0.307	0.407
	Range	0.170-	--	0.151-	0.141-		--	--
		0.428	--	0.305	0.591		--	--
	# Samples	10	1	6	8		1	1
Ag	Mean	0.20	0.181	0.21	0.24		0.213	0.39
	Range	0.08-	--	0.11-	0.07-		--	--
		0.41	--	0.56	0.59		--	--
	# Samples	10	1	6	8		1	1
Mn	Mean	1.03	5.505	0.80	3.23		6.665	0.793
	Range	0.22-	--	0.40-	0.50-		--	--
		1.22	--	1.20	9.78		--	--
	# Samples	10	1	6	8		1	1
Pb	Mean	0.88	1.077	0.60	1.12		0.900	0.878
	Range	0.50-	--	0.46-	0.51		--	--
		1.63	--	0.82	2.52		--	--
	# Samples	10	1	6	8		1	1
Co	Mean	0.21	0.686	0.09	0.47		0.120	0.217
	Range	0.07-	--	0.06-	0.08-		--	--
		0.77	--	0.12	2.80		--	--
	# Samples	10	1	6	8		1	1
Ni	Mean	1.27	--	2.02	2.23		--	5.44
	Range	0.81-	--	0.528-	0.77-		--	--
		1.847	--	4.711	5.10		--	--
	# Samples	10	0	6	6		0	1
Cr	Mean	0.410	0.852	0.293	0.711		0.553	0.657
	Range	0.25-	--	0.239-	0.34-		--	--
		0.661	--	0.354	1.43		--	--
	# Samples	10	1	6	8		1	1
Al	Mean	3.03	--	2.42	12.60		--	4.23
	Range	1.629-	--	1.71-	1.98-		--	--
		6.211	--	3.85	25.85		--	--
	# Samples	10	0	6	7		0	1
V	Mean	0.266	0.722	0.281	0.684		1.110	0.340
	Range	0.200-	--	0.158-	0.309-		--	--
		0.373	--	0.360	0.741		--	--
	# Samples	10	1	6	8		1	1

Metals Concentrations in Echinoderm and Mollusc Tissues

Arctica

µgm/gm Dry Weight

		14	9	17	1	2	5	8	11
Fe	Mean	192.74	275.05	339.9	523.21	205.90	213.07	397.50	346.54
	Range	111.50-245.94	182.36-422.02	108.08-616.61	87.98-3349.20	73.05-372.60	147.16-250.85	142.23-1059.80	233.72-737.75
	# Samples	3	10	8	12	4	3	5	6
Cu	Mean	6.29	6.11	5.28	9.74	7.23	6.29	6.87	5.51
	Range	4.96-8.25	3.41-8.13	3.96-6.52	4.11-36.30	4.28-12.78	4.81-8.01	3.21-9.97	4.36-7.02
	# Samples	3	10	8	12	4	3	5	6
Zn	Mean	111.44	65.84	70.496	104.48	100.865	73.19	100.69	87.982
	Range	66.05-153.27	50.34-84.51	49.21-84.78	21.92-370.45	61.75-150.32	51.00-94.33	52.55-164.80	43.180-143.23
	# Samples	3	10	8	12	4	3	5	6
Cd	Mean	3.94	2.134	3.378	2.45	2.588	3.461	2.19	2.77
	Range	3.167-5.337	1.424-2.862	1.604-5.00	1.29-3.22	2.624-2.822	1.80-4.700	1.17-2.74	1.627-4.079
	# Samples	3	9	8	11	4	3	5	6
Ag	Mean	2.273	2.026	2.087	2.30	2.220	1.366	1.97	1.785
	Range	1.35-3.68	0.759-3.220	1.070-2.720	0.41-8.50	0.85-3.86	0.82-2.05	0.86-5.71	1.250-2.580
	# Samples	3	10	8	12	4	3	5	6
Mn	Mean	3.277	8.532	9.069	6.78	6.055	7.040	6.70	8.353
	Range	3.14-3.43	4.86-14.24	6.100-12.30	2.89-13.93	2.81-9.18	5.160-10.79	4.89-10.05	4.37-19.65
	# Samples	3	10	8	11	4	3	5	6
Pb	Mean	5.163	5.373	5.98	5.68	4.883	7.577	6.24	6.425
	Range	3.78-6.30	3.22-7.52	4.33-7.50	3.54-7.82	4.120-6.410	4.99-9.90	4.15-9.12	4.50-9.70
	# Samples	3	10	8	11	4	3	5	6
Co	Mean	1.50	1.126	0.764	1.48	1.068	1.073	1.12	1.230
	Range	0.89-2.03	0.720-1.520	0.540-1.040	0.45-4.52	0.54-1.94	0.69-1.28	0.81-1.95	0.87-1.94
	# Samples	3	10	8	11	4	3	5	6
Ni	Mean	19.50	8.80	8.80	10.82	9.73	12.10	12.60	14.47
	Range	11.42-24.38	4.89--15.84	5.29-15.06	2.51-16.29	5.00-16.69	5.20-16.85	5.95-23.77	10.26-21.99
	# Samples	3	10	8	9	4	3	4	6
Cr	Mean	2.88	4.33	3.40	3.17	2.51	3.38	2.62	3.38
	Range	2.18-3.73	3.54-6.08	2.03-4.07	1.87-3.99	2.07-2.80	2.59-4.24	1.39-3.34	2.03-4.89
	# Samples	3	10	8	12	4	3	5	6
Al	Mean	11.63	36.79	26.51	30.18	22.05	31.32	34.89	19.91
	Range	2.28-17.23	16.57-92.89	15.03-63.20	16.86-60.34	17.03-25.55	19.92-47.01	11.13-75.50	12.27-24.38
	# Samples	3	10	7	11	3	3	5	6
V	Mean	2.12	4.02	3.37	2.90	2.86	2.36	2.13	2.56
	Range	1.86-2.53	2.59-5.77	2.30-4.01	2.55-3.60	2.58-3.34	1.26-3.17	1.49-3.61	1.90-3.25
	# Samples	3	10	8	12	4	3	5	6

Metals Concentrations in Echinoderm and Mollusc Tissues

Arctica

µgm/gm Dry Weight

		E	C	D	G	B	A	H
Fe	Mean	377.80	624.00	226.90	504.40		630.95	292.8
	Range	122.73-	--	46.42-	181.57-		--	--
		894.30	--	395.60	1148.11		--	--
	# Samples	10	1	6	8		1	1
Cu	Mean	6.11	4.2	6.40	5.07		4.334	7.350
	Range	3.91-	--	4.57-	3.18-		--	--
		8.14		11.12	6.54		--	--
	# Samples	10	1	6	8		1	1
Zn	Mean	74.98	39.0	83.76	52.28		41.334	140.99
	Range	53.26-	--	61.93-	24.54-		--	--
		112.16		126.41	70.98			
	# Samples	10	1	6	8		1	1
Cd	Mean	2.59	1.6	2.19	1.88		1.308	3.891
	Range	1.71-	--	1.47-	1.107-		--	--
		3.89	11	2.65	2.890		--	--
	# Samples	10	1	6	8		1	1
Ag	Mean	1.86	0.7	1.89	1.406		0.909	0.378
	Range	0.78	--	0.98-	0.360-		--	--
		4.11	--	4.95	5.080		--	--
	# Samples	10	1	6	8		1	1
Mn	Mean	9.12	22.4	7.01	14.566		28.346	7.568
	Range	5.43-	--	3.53-	4.30-		--	--
		23.39	--	9.74	28.80		--	--
	# Samples	10	1	6	8		1	1
Pb	Mean	7.84	4.4	5.31	5.673		3.830	8.378
	Range	5.73-	--	4.16-	2.42-		--	--
		11.45	--	7.13	8.39		--	--
	# Samples	10	1	6	8		1	1
Co	Mean	2.25	2.8	0.751	2.584		0.512	2.074
	Range	0.61-	--	0.536-	0.480-		--	--
		9.59	--	1.087	8.230		--	--
	# Samples	10	1	6	8		1	1
Ni	Mean	11.47	--	17.62	24.27		--	51.9
	Range	6.74-	--	4.57-	6.97-		--	--
		15.76	--	38.28	46.64		--	--
	# Samples	8	1	6	6		1	1
Cr	Mean	3.79	3.47	2.59	3.73		2.35	6.27
	Range	2.156-	--	2.07-	2.98-		--	--
		5.15	--	3.13	5.46		--	--
	# Samples	10	1	6	8		1	1
Al	Mean	28.96	--	21.51	62.00		--	40.36
	Range	18.16-	--	15.37-	17.01-		--	--
		53.47	--	33.33	123.44		--	--
	# Samples	10	1	6	7		1	1
V	Mean	2.47	2.94	2.49	3.69		4.74	3.24
	Range	2.00-	--	1.28-	2.34-		--	--
		2.99	--	3.18	4.59		--	--
	# Samples	10	1	6	8		1	1

Metals Concentrations in Echinoderm and Mollusc Tissues

Arctica — µgm/gm Ash Weight

		14	9	17	1	2	5	8	11
Fe	Mean	627.60	972.8	1324.15	727.18	861.5	679.5	1247.2	976.2
	Range	296.8-896.8	615.7-1373.0	416.3-2798.0	330.4-1131.0	368.9-1931.0	520.0-816.7	498.8-3299.0	635.2-1856.0
	# Samples	3	10	8	11	4	3	5	6
Cu	Mean	20.23	22.11	20.72	27.93	24.05	20.02	19.92	15.97
	Range	13.19-30.08	9.99-35.86	12.72-29.62	11.33-61.80	10.44-36.14	17.00-23.37	10.12-26.08	10.96-21.36
	# Samples	3	10	8	11	4	3	5	6
Zn	Mean	256.0	236.0	270.0	250.0	312.0	241.0	319.0	255.0
	Range	206.21-306.1	147.1-332.7	166.7-355.4	125.1-457.9	227.3-425.0	148.1-333.3	168.5-513.0	108.6-359.6
	# Samples	2	10	8	11	4	3	5	6
Cd	Mean	12.76	7.698	13.128	9.891	8.68	10.90	6.984	8.015
	Range	8.43-19.61	4.60-12.23	6.18-22.71	4.16-27.91	6.15-13.65	6.37-13.65	3.69-9.62	5.26-13.14
	# Samples	3	10	8	11	4	3	5	6
Ag	Mean	4.59	6.88	5.18	5.26	6.68	4.28	6.27	4.60
	Range	3.59-5.59	3.35-8.80	3.28-17.13	2.87-10.48	4.38-11.29	2.89-5.96	2.69-18.30	2.88-7.85
	# Samples	2	10	8	11	4	3	5	6
Mn	Mean	10.30	29.60	41.20	48.40	22.10	22.80	21.50	23.50
	Range	8.36-12.50	16.41-51.20	21.36-60.33	10.75-264.94	7.95-47.57	15.00-35.19	15.40-35.26	11.50-49.44
	# Samples	3	10	8	11	4	3	5	6
Pb	Mean	16.50	19.20	22.90	19.80	22.90	24.20	19.80	18.40
	Range	10.04-19.72	10.79-28.96	17.44-56.76	13.46-25.48	10.03-22.75	17.63-32.30	13.06-29.24	11.34-24.40
	# Samples	3	10	8	11	4	3	5	6
Co	Mean	4.80	4.03	4.20	4.34	3.17	3.53	3.52	3.65
	Range	2.77-7.42	2.59-5.56	2.06-6.53	0.96-11.95	2.49-4.74	1.99-4.52	1.81-6.13	2.18-6.25
	# Samples	3	10	8	11	4	3	5	6
Ni	Mean	61.66	31.06	33.53	37.10	28.96	40.35	39.93	42.90
	Range	35.65-88.92	17.576-46.705	24.00-58.04	18.42-54.94	15.377-40.66	15.128-59.556	19.09-74.78	25.518-70.83
	# Samples	3	10	8	9	4	3	4	6
Cr	Mean	9.31	15.75	13.38	10.86	8.12	10.769	8.20	9.64
	Range	5.82-13.62	10.58-26.82	7.35-18.55	8.00-22.48	6.293-10.706	9.185-12.308	4.895-10.73	6.175-12.29
	# Samples	3	10	8	11	4	3	5	6
Al	Mean	34.07	127.36	96.21	76.37	59.59	98.352	106.85	56.80
	Range	8.33-48.02	48.42-256.88	57.92-198.35	20.38-156.11	49.85-66.67	70.37-136.53	39.04-219.07	37.32-74.97
	# Samples	3	10	7	11	3	3	5	6
V	Mean	6.66	14.16	13.15	9.54	9.41	7.501	6.74	7.33
	Range	4.95-7.909	7.594-22.18	6.747-18.195	1.21-25.19	6.916-13.382	4.444-10.37	5.245-11.594	6.239-9.615
	# Samples	3	10	8	12	4	3	5	6

Metals Concentrations in Echinoderm and Mollusc Tissues

Arctica — µmg/gm Ash Weight

		E	C	D	G	B	A	H
Fe	Mean	1138.18	6092.0	791.53	3383.5		8156.00	915.0
	Range	329.50-	--	496.2-	616.1-		--	--
		2114.00	--	1280.0	8987.0-		--	--
	# Samples	10	1	6	8		1	1
Cu	Mean	19.11	40.52	20.09	28.83		56.62	22.97
	Range	13.39-	--	14.35-	17.49-		--	--
		32.33	--	31.92	47.94		--	--
	# Samples	10	1	6	8		1	1
Zn	Mean	233.00	381.00	266.00	303.00		534.00	441.00
	Range	114.40-	--	199.6-	174.4-		--	--
		278.80	--	362.7	464.4			
	# Samples	10	1	6	8		1	1
Cd	Mean	8.048	16.09	7.10	11.29		16.91	12.16
	Range	4.59-	--	4.23-	4.47-		--	--
		13.03	--	8.93	20.92		--	--
	# Samples	10	1	6	8		1	1
Ag	Mean	5.64	7.19	6.04	7.15		11.76	1.18
	Range	2.15-	--	3.05-	1.18-		--	--
		10.63	--	15.58	17.25		--	--
	# Samples	10	1	6	8		1	1
Mn	Mean	29.20	219.00	22.7	99.7		366.00	23.6
	Range	14.63-	--	11.13-	14.59-		--	--
		78.76	--	33.83	225.49		--	--
	# Samples	10	1	6	8		1	1
Pb	Mean	22.00	42.80	17.10	29.00		49.50	26.20
	Range	15.39-	--	12.82-	15.53-		--	--
		51.70	--	24.05	58.17		--	--
	# Samples	10	1	6	8		1	1
Co	Mean	5.94	27.30	2.43	15.5		6.62	6.48
	Range	2.18-	--	1.54-	2.43-		--	--
		20.54	--	3.39	64.46		--	--
	# Samples	10	1	6	8		1	1
Ni	Mean	35.20	--	56.95	71.19		25.25	62.16
	Range	23.26-	--	15.428-	29.77-		--	--
		43.19	--	133.037	161.56		--	--
	# Samples	7	1	6	6		1	1
Cr	Mean	11.89	33.91	8.30	21.98		30.392	79.59
	Range	7.01-	--	6.701-	10.12-		--	--
		20.99	--	10.32	33.17		--	--
	# Samples	10	1	6	8		1	1
Al	Mean	88.51	--	68.80	484.04		--	126.13
	Range	44.03-	--	50.04-	57.72-		--	--
		162.73	--	112.49	1140.00		--	--
	# Samples	10	1	6	7		1	1
V	Mean	7.62	28.74	7.96	21.20		61.27	10.14
	Range	5.68-	--	4.45-	9.32-		--	--
		10.80	--	10.32	35.95		--	--
	# Samples	10	1	6	8		1	1

Metals Concentrations in Echinoderm and Mollusc Tissues

Echinarachnius — µgm/gm Wet Weight

		14	9	17	1	2	5	8	11
Fe	Mean	29.31	44.90	24.69	53.99		53.82	291.26	273.44
	Range	--	--	22.41-	33.64-		--	--	--
		--	--	28.12	80.35		--	--	--
	# Samples	1	1	3	3		1	1	1
Cu	Mean	6.42	7.501	7.08	4.80		7.003	6.230	6.583
	Range	--	--	6.47-	4.13-		--	--	--
		--	--	7.97	5.48		--	--	--
	# Samples	1	1	3	3		1	1	1
Zn	Mean	6.71	5.41	3.540	6.023		3.68	4.17	4.30
	Range	--	--	3.06-	4.94-		--	--	--
		--	--	3.87	7.26		--	--	--
	# Samples	1	1	3	3		1	1	1
Cd	Mean	0.292	0.086	0.08	0.28		0.107	0.031	0.000
	Range	--	--	0.034-	0.217-		--	--	--
		--	--	0.127	0.313		--	--	--
	# Samples	1	1	3	3		1	1	1
Ag	Mean	0.92	0.52	0.52	0.663		0.34	0.49	0.22
	Range	--	--	0.48-	0.56-		--	--	--
		--	--	0.57	0.77		--	--	--
	# Samples	1	1	3	3		1	1	1
Mn	Mean	3.00	1.61	1.873	3.593		1.33	2.19	1.93
	Range	--	--	1.75-	3.27-		--	--	--
		--	--	2.00	3.80		--	--	--
	# Samples	1	1	3	3		1	1	1
Pb	Mean	40.97	22.41	21.35	65.60		17.91	20.93	19.37
	Range	--	--	21.10-	26.00-		--	--	--
		--	--	22.19	136.67		--	--	--
	# Samples	1	1	3	3		1	1	1
Co	Mean	0.00	0.14	0.06	0.097		0.14	0.03	0.22
	Range	--	--	0.03-	0.05-		--	--	--
		--	--	0.10	0.17		--	--	--
	# Samples	1	1	3	3		1	1	1
Ni	Mean	0.00	11.909	7.981	0.113		3.069	7.882	1.449
	Range	--	--	4.64-	0.026-		--	--	--
		--	--	13.34	0.159		--	--	--
	# Samples	1	1	3	3		1	1	1
Cr	Mean	2.693	3.394	3.099	1.587		2.744	3.489	2.646
	Range	--	--	2.99-	1.068-		--	--	--
		--	--	3.23	2.464		--	--	--
	# Samples	1	1	3	3		1	1	1
Al	Mean	13.828	17.835	25.59	36.156		19.497	166.978	178.886
	Range	--	--	11.266-	20.217-		--	--	--
		--	--	53.88	55.80		--	--	--
	# Samples	1	1	3	3		1	1	1
V	Mean	4.003	4.315	4.356	3.559		4.333	4.673	3.779
	Range	--	--	4.12-	3.18-		--	--	--
		--	--	4.50	3.95		--	--	--
	# Samples	1	1	3	3		1	1	1

Metals Concentrations in Echinoderm and Mollusc Tissues

Echinarachnius

µgm/gm Wet Weight

		E	C	D	G	B	A	H
Fe	Mean	21.57	18.44		44.97		29.89	
	Range	18.33-	13.04		--		--	
		25.91	23.84		--		--	
	# Samples	3	2		1		1	
Cu	Mean	5.80	5.84		6.012		5.91	
	Range	5.35-	5.78-		--		--	
		6.09	5.89		--		--	
	# Samples	3	2		1		1	
Zn	Mean	4.176	18.440		8.30		6.34	
	Range	3.59-	13.04-		--		--	
		4.76	23.84		--		--	
	# Samples	3	2		1		1	
Cd	Mean	0.11	0.205		0.241		0.365	
	Range	0.111-	0.199-		--		--	
		0.115	0.211		--		--	
	# Samples	3	2		1		1	
Ag	Mean	0.403	0.785		0.79		0.80	
	Range	0.39-	0.78-		--		--	
		0.41	0.79		--		--	
	# Samples	3	2		1		1	
Mn	Mean	1.433	3.275		3.26		3.99	
	Range	1.24-	3.18-		--		--	
		1.57	3.37		--		--	
	# Samples	3	2		1		1	
Pb	Mean	17.677	33.76		39,26		40.16	
	Range	17.18-	33.71-		--		--	
		18.14	33.81		--		--	
	# Samples	3	2		1		1	
Co	Mean	0.037	0.135		0.06		0.00	
	Range	0.02-	0.09-		--		--	
		0.07	0.18		--		--	
	# Samples	3	2		1		1	
Ni	Mean	1.538	0.056		30.275		0.107	
	Range	0.204-	0.00-		--		--	
		3,93	0.112		--		--	
	# Samples	3	2		1		1	
Cr	Mean	2.64	2.480		3.949		3.253	
	Range	2.58-	2.452-		--		--	
		2.73	2.507		--		--	
	# Samples	3	2		1		1	
Al	Mean	15.630	17.89		67.068		23.947	
	Range	11.19-	13.659-		--		--	
		21.56	22.127		--		--	
	# Samples	3	2		1		1	
V	Mean	3.845	3.947		4.074		3.932	
	Range	3.688-	3.857-		--		--	
		3.94	4.037		--		--	
	# Samples	3	2		1		1	

Metals Concentrations in Echinoderm and Mollusc Tissues

Echinarachnius — µgm/gm Dry Weight

		14	9	17	1	2	5	8	11
Fe	Mean	58.72	80.19	42.74	103.41		117.29	520.89	533.11
	Range	--	--	37.31-	74.12-		--	--	--
		--	--	49.41	150.06		--	--	--
	# Samples	1	1	3	3		1	1	1
Cu	Mean	12.86	13.39	12.30	9.46		15.26	13.44	12.83
	Range	--	--	10.92-	7.72-		--	--	--
		--	--	14.01	12.07		--	--	--
	# Samples	1	1	3	3		1	1	1
Zn	Mean	13.44	9.66	5.77	11.80		8.02	7.31	8.38
	Range	--	--	5.38-	8.86-		--	--	--
		--	--	6.53	16.00		--	--	--
	# Samples	1	1	3	3		1	1	1
Cd	Mean	0.585	0.153	0.132	0.50		0.233	0.054	0.00
	Range	--	--	0.059-	0.39-		--	--	--
		--	--	0.214	0.58		--	--	--
	# Samples	1	1	3	3		1	1	1
Ag	Mean	1.84	0.93	0.90	1.31		0.74	0.86	0.43
	Range	--	--	0.84-	1.05-		--	--	--
		--	--	1.00	1.70		--	--	--
	# Samples	1	1	3	3		1	1	1
Mn	Mean	6.01	2.88	3.25	7.04		2.90	3.84	3.77
	Range	--	--	3.08-	6.11-		--	--	--
		--	--	3.37	8.37		--	--	--
	# Samples	1	1	3	3		1	1	1
Pb	Mean	82.08	40.03	37.63	122.66		39.03	36.71	38.06
	Range	--	--	37.10-	48.56-		--	--	--
		--	--	38.34	245.14		--	--	--
	# Samples	1	1	3	3		1	1	1
Co	Mean	0.00	0.25	0.11	0.19		0.31	0.05	0.43
	Range	--	--	0.05-	0.11-		--	--	--
		--	--	0.18	0.32		--	--	--
	# Samples	1	1	3	3		1	1	1
Ni	Mean	0.00	21.27	13.719	0.229		6.689	13.825	3.328
	Range	--	--	8.165-	0.049-		--	--	--
		--	--	22.518	0.35		--	--	--
	# Samples	1	1	3	3		1	1	1
Cr	Mean	2.693	6.062	5.372	3.058		5.980	6.120	6.076
	Range	--	--	5.258-	2.226-		--	--	--
		--	--	5.456	4.602		--	--	--
	# Samples	1	1	3	3		1	1	1
Al	Mean	13.828	31.854	43.729	68.98		42.49	292.89	410.88
	Range	--	--	19.81-	49.54-		--	--	--
		--	--	90.93	104.21		--	--	--
	# Samples	1	1	3	3		1	1	1
V	Mean	4.003	7.707	7.562	6.907		9.443	8.197	8.681
	Range	--	--	6.95-	6.626-		--	--	--
		--	--	7.929	7.09		--	--	--
	# Samples	1	1	3	3		1	1	1

Metals Concentrations in Echinoderm and Mollusc Tissues

Echinarachnius — µgm/gm Dry Weight

		E	C	D	G	B	A	H
Fe	Mean	39.54	34.90		86.27		55.55	
	Range	35.58-	24.43-		--		--	
		44.82	45.37		--		--	
	# Samples	3	2		1		1	
Cu	Mean	10.91	11.205		12.68		10.98	
	Range	10.01-	11.20-		--		--	
		11.50	11.21		--		--	
	# Samples	3	2		1		1	
Zn	Mean	7.86	13.80		15.92		11.78	
	Range	6.71-	12.01-		--		--	
		9.22	15.59		--		--	
	# Samples	3	2		1		1	
Cd	Mean	0.2113	0.39		0.460		0.680	
	Range	0.207-	0.35-		--		--	
		0.217	0.40		--		--	
	# Samples	3	2		1		1	
Ag	Mean	0.76	1.48		1.52		1.49	
	Range	0.73-	1.46-		--		--	
		0.79	1.50		00		00	
	# Samples	3	2		1		1	
Mn	Mean	2.71	6.18		6.25		7.42	
	Range	2.32-	6.05-		--		--	
		2.93	6.31		--		--	
	# Samples	3	2		1		1	
Pb	Mean	33.22	63.75		75.32		74.64	
	Range	32.11-	63.34-		--		--	
		34.33	64.15		--		--	
	# Samples	3	2		1		1	
Co	Mean	0.07	0.26		0.12		0.00	
	Range	0.04-	0.17-		--		--	
		0.13	0.34		--		--	
	# Samples	3	2		1		1	
Ni	Mean	2.875	0.105		58.08		0.199	
	Range	0.396-	0.00-		--		--	
		7.35	0.211		--		--	
	# Samples	3	2		1		1	
Cr	Mean	4.955	4.679		7.576		6.045	
	Range	4.82-	4.666-		--		--	
		5.04	4.697		--		--	
	# Samples	3	2		1		1	
Al	Mean	29.538	33.85		128.67		44.51	
	Range	20.914-	25.59-		--		--	
		41.793	42.11		--		--	
	# Samples	3	2		1		1	
V	Mean	7.228	7.453		7.816		7.307	
	Range	6.89-	7.225-		--		--	
		7.566	7.681		--		--	
	# Samples	3	2		1		1	

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - muscle only — µgm/gm Wet Weight

		14	9	17	1	2	5	8	11
Fe	Mean	17.41		11.74				5.05	31.66
	Range	9.83-		--				--	14.18-
		25.20		--				--	65.72
	# Samples	5		1				1	3
Cu	Mean	0.034		0.272				0.290	0.24
	Range	0.29-		--				--	0.23-
		0.43		--				--	0.26
	# Samples	5		1				1	3
Zn	Mean	16.11		13.620				12.861	17.78
	Range	14.28-		--				--	13.72-
		19.01		--				--	24.10
	# Samples	5		1				1	3
Cd	Mean	1.09		0.302				0.155	0.68
	Range	0.68-		--				--	0.47-
		1.43		--				--	0.85
	# Samples	5		1				1	3
Ag	Mean	0.06		0.052				0.062	0.05
	Range	0.05-		--				--	0.03-
		0.07		--				--	0.06
	# Samples	5		1				1	3
Mn	Mean	1.83		0.479				0.923	3.02
	Range	0.80-		--				--	1.09-
		4.80		--				--	6.03
	# Samples	5		1				1	3
Pb	Mean	0.44		0.332				0.373	0.48
	Range	0.37-		--				--	0.44
		0.48		--				--	0.51
	# Samples	5		1				1	3
Co	Mean	0.04		8.708				0.073	0.04
	Range	0.02-		--				--	0.02-
		0.07		--				--	0.05
	# Samples	4		1				1	3
Ni	Mean	3.470		0.086				0.156	1.128
	Range	0.593-		--				--	0.153-
		6.589		--				--	2.638
	# Samples	4		1				1	3
Cr	Mean	0.6014		0.112				0.104	0.437
	Range	0.116-		--				--	0.12-
		1.162		--				--	1.001
	# Samples	4		1				1	3
Al	Mean	6.310		5.094				4.356	13.758
	Range	2.857-		--				--	5.519-
		11.074		--				--	25.599
	# Samples	5		1				1	3
V	Mean	0.182		0.129				0.207	0.228
	Range	0.099-		--				--	0.055-
		0.313		--				--	0.329
	# Samples	4		1				1	3

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - muscle only

µg/gm Wet Weight

		E	C	D	G	B	A	H
Fe	Mean		32.39					
	Range		--					
			--					
	# Samples		1					
Cu	Mean		0.555					
	Range		--					
			--					
	# Samples		1					
Zn	Mean		14.390					
	Range		--					
			--					
	# Samples		1					
Cd	Mean		0.317					
	Range		--					
			--					
	# Samples		1					
Ag	Mean		0.051					
	Range		--					
			--					
	# Samples		1					
Mn	Mean		0.816					
	Range		--					
			--					
	# Samples		1					
Pb	Mean		0.334					
	Range		--					
			--					
	# Samples		1					
Co	Mean		0.215					
	Range		--					
			--					
	# Samples		1					
Ni	Mean		--					
	Range		--					
			--					
	# Samples		1					
Cr	Mean		0.136					
	Range		--					
			--					
	# Samples		1					
Al	Mean		4.192					
	Range		--					
			--					
	# Samples		1					
V	Mean		0.113					
	Range		--					
			--					
	# Samples		1					

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - muscle only — µgm/gm Dry weight

		14	9	17	1	2	5	8	11
Fe	Mean	96.99		50.42				10.005	161.46
	Range	58.87-		--				--	71.52-
		127.65		--				--	328.45
	# Samples	5		1				1	3
Cu	Mean	1.94		1.168				0.575	1.25
	Range	1.69-		--				--	1.16-
		2.46		--				--	1.31
	# Samples	5		1				1	3
Zn	Mean	90.873		58.49				25.45	93.92
	Range	81.091-		--				--	68.56-
		113.807		--				--	134.86
	# Samples	5		1				1	3
Cd	Mean	6.10		1.298				0.308	3.48
	Range	3.791-		--				--	2.63-
		8.40		--				--	4.29
	# Samples	5		1				.	3
Ag	Mean	0.332		0.223				0.123	0.234
	Range	0.281-		--				--	0.18-
		0.411		--				--	0.30
	# Samples	5		1				1	3
Mn	Mean	10.609		2.058				1.826	16.30
	Range	4.53-		--				--	5.49-
		28.70		--				--	33.73
	# Samples	5		1				1	3
Pb	Mean	2.498		1.427				0.739	2.50
	Range	2.125-		--				--	2.23-
		2.894		--				--	2.75
	# Samples	5		1				1	3
Co	Mean	0.206		0.037				0.144	0.19
	Range	0.116-		--				--	0.124-
		0.392		--				--	0.275
	# Samples	4		1				1	3
Ni	Mean	19.236		0.371				0.308	5.715
	Range	3.549-		--				--	0.856-
		37.416		--				--	13.307
	# Samples	4		1				1	3
Cr	Mean	3.386		0.482				0.205	2.224
	Range	0.634-		--				--	0.673-
		6.599		--				--	5.057
	# Samples	4		1				1	3
Al	Mean	34.919		21.876				8.621	70.013
	Range	16.219-		--				--	30.887-
		56.083		--				--	127.92
	# Samples	5		1				1	3
V	Mean	0.647		0.556				15.519	1.153
	Range	0.559-		--				--	0.306-
		1.584		--				--	1.663
	# Samples	4		1				1	3

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - muscle only — µgm/gm Dry Weight

		E	C	D	G	B	A	H
Fe	Mean		140.381					
	Range		--					
			--					
	# Samples		1					
Cu	Mean		2.406					
	Range		--					
			--					
	# Samples		1					
Zn	Mean		62.349					
	Range		--					
			--					
	# Samples		1					
Cd	Mean		1.375					
	Range		--					
			--					
	# Samples		1					
Ag	Mean		0.221					
	Range		--					
			--					
	# Samples		1					
Mn	Mean		3.535					
	Range		--					
			--					
	# Samples		1					
Pb	Mean		1.448					
	Range		--					
			--					
	# Samples		1					
Co	Mean		0.933					
	Range		--					
			--					
	# Samples		1					
Ni	Mean		--					
	Range		--					
			--					
	# Samples		1					
Cr	Mean		0.589					
	Range		--					
			--					
	# Samples		1					
Al	Mean		18.164					
	Range		--					
			--					
	# Samples		1					
V	Mean		0.491					
	Range		--					
			--					
	# Samples		1					

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - muscle only — µgm/gm Ash Weight

		14	9	17	1	2	5	8	11
Fe	Mean	813.98		552.8				270.0	1478.0
	Range	545.4-		--				--	676.1-
		1385.0		--				--	3061.0
	# Samples	5		1				1	3
Cu	Mean	15.65		12.81				15.56	11.32
	Range	12.71-		--				--	10.86-
		22.28		--				--	12.04
	# Samples	5		1				1	3
Zn	Mean	742.0		641.3				688.9	831.0
	Range	539.9-		--				--	638.9-
		1056.8						--	1113.6
	# Samples	5						1	3
Cd	Mean	51.0		14.23				8.33	31.7
	Range	28.65-		--				--	21.72-
		86.74		--				--	40.57
	# Samples	5		1				1	3
Ag	Mean	2.65		2.44				3.33	2.15
	Range	2.27-		--				--	1.52-
		3.41		--				--	2.85
	# Samples	5		1				1	3
Mn	Mean	80.97		22.56				49.44	140.2
	Range	32.93-		--				--	51.8-
		210.17		--				--	278.54
	# Samples	5		1				1	3
Pb	Mean	20.19		15.65				20.00	22.5
	Range	15.45-		--				--	21.07-
		27.27		--				--	23.61
	# Samples	5		1				1	3
Co	Mean	1.35		0.41				3.89	1.77
	Range	0.00-		--				--	1.16-
		2.85		--				--	2.27
	# Samples	5		1				1	3
Ni	Mean	161.606		4.065				8.333	53.54
	Range	25.989-		--				--	7.071-
		271.951		--				--	128.79
	# Samples	5		1				1	3
Cr	Mean	26.52		5.285				5.555	20.716
	Range	5.085-		--				--	5.555-
		47.967		--				--	47.799
	# Samples	5		1				1	3
Al	Mean	301.14		239.84				233.33	643.81
	Range	117.886-		--				--	255.05-
		670.455		--				--	1192.13
	# Samples	5		1				1	3
V	Mean	8.899		6.098				11.111	10.712
	Range	4.065-		--				--	2.525-
		18.939		--				--	15.723
	# Samples	4		1				1	3

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - muscle only — µgm/gm Ash Weight

		E	C	D	G	B	A	H
Fe	Mean		1869.0					
	Range		--					
			--					
	# Samples		1					
Cu	Mean		32.03					
	Range		--					
			--					
	# Samples		1					
Zn	Mean		830.1					
	Range		--					
			--					
	# Samples		1					
Cd	Mean		18.30					
	Range		--					
			--					
	# Samples		1					
Ag	Mean		2.94					
	Range		--					
			--					
	# Samples		1					
Mn	Mean		47.06					
	Range		--					
			--					
	# Samples		1					
Pb	Mean		19.28					
	Range		--					
			--					
	# Samples		1					
Co	Mean		12.42					
	Range		--					
			--					
	# Samples		1					
Ni	Mean		--					
	Range		--					
			--					
	# Samples		1					
Cr	Mean		7.843					
	Range		--					
			--					
	# Samples		1					
Al	Mean		241.83					
	Range		--					
			--					
	# Samples		1					
V	Mean		6.535					
	Range		--					
			--					
	# Samples		1					

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - viscera & foot µgm/gm Wet Weight

		14	9	17	1	2	5	8	11
Fe	Mean	111.66		1.23				171.68	233.41
	Range	57.55-		--				--	205.47-
		164.54		--				--	274.15
	# Samples	5		1				1	3
Cu	Mean	1.01		2.52				0.996	1.27
	Range	0.87-		--				--	0.85-
		1.19		--				--	1.58
	# Samples	5		1				1	3
Zn	Mean	10.37		16.119				15.809	9.72
	Range	7.80-		--				--	9.25-
		14.96		--				--	10.14
	# Samples	5		1				1	3
Cd	Mean	10.69		8.993				3.977	16.01
	Range	8.28-		--				--	11.23-
		14.95		--				--	19.23
	# Samples	5		1				1	3
Ag	Mean	0.15		0.097				0.136	0.12
	Range	0.11-		--				--	0.08-
		0.20		--				--	0.16
	# Samples	5		1				1	3
Mn	Mean	3.90		2.549				8.292	7.87
	Range	2.94-		--				--	6.07-
		5.36		--				--	10.07
	# Samples	5		1				1	3
Pb	Mean	0.40		0.534				0.743	0.54
	Range	0.33-		--				--	0.50-
		0.50		--				--	0.57
	# Samples	5		1				1	3
Co	Mean	0.17		0.136				0.063	0.17
	Range	0.07-		--				--	0.14-
		0.43		--				--	0.19
	# Samples	5		1				1	3
Ni	Mean	0.499		0.484				2.940	0.508
	Range	0.346-		--				--	0.488-
		0.749		--				--	0.542
	# Samples	4		1				1	3
Cr	Mean	0.4103		0.738				0.471	0.782
	Range	0.372-		--				--	0.705-
		0.447		--				--	0.913
	# Samples	5		1				1	3
Al	Mean	37.56		50.522				62.83	91.686
	Range	7.21[illegible]		--				--	15.54-
		58.534		--				--	135.69
	# Samples	5		1				1	3
V	Mean	1.828		4.454				2.039	2.683
	Range	1.555-		--				--	2.268-
		2.011		--				--	2.982
	# Samples	5		1				1	3

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - viscera & foot

µgm/gm Wet Weight

		E	C	D	G	B	A	H
Fe	Mean		151.09					
	Range		--					
			--					
	# Samples		1					
Cu	Mean		1.484					
	Range		--					
			--					
	# Samples		1					
Zn	Mean		12.394					
	Range		--					
			--					
	# Samples		1					
Cd	Mean		7.424					
	Range		--					
			--					
	# Samples		1					
Ag	Mean		0.087					
	Range		--					
			--					
	# Samples		1					
Mn	Mean		4.571					
	Range		--					
			--					
	# Samples		1					
Pb	Mean		0.624					
	Range		--					
			--					
	# Samples		1					
Co	Mean		0.166					
	Range		--					
			--					
	# Samples		1					
Ni	Mean		0.345					
	Range		--					
			--					
	# Samples		1					
Cr	Mean		0.807					
	Range		--					
			--					
	# Samples		1					
Al	Mean		68.713					
	Range		--					
			--					
	# Samples		1					
V	Mean		3.660					
	Range		--					
			--					
	# Samples		1					

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - viscera & foot — µgm/gm Dry Weight

		14	9	17	1	2	5	8	11
Fe	Mean	849.56		5.416				906.22	1207.8
	Range	575.13-		--				--	1022.8-
		1093.89		--				--	1321.9
	# Samples	5		1				1	3
Cu	Mean	8.09		11.041				5.260	6.77
	Range	6.67-		--				--	4.11-
		9.84		--				--	9.85
	# Samples	5		1				1	3
Zn	Mean	86.526		70.602				83.44	51.01
	Range	53.937-		--				--	42.87-
		149.49		--				--	63.09
	# Samples	5		1				1	3
Cd	Mean	87.865		39.390				20.996	84.23
	Range	55.05-		--				--	54.17-
		137.48		--				--	109.39
	# Samples	5		1				1	3
Ag	Mean	1.211		0.427				0.718	0.65
	Range	0.836		--				--	0.358-
		1.69		--				--	0.968
	# Samples	5		1				1	3
Mn	Mean	31.521		11.166				43.758	40.32
	Range	21.20-		--				--	34.67-
		49.32		--				--	48.54
	# Samples	5		1				1	3
Pb	Mean	3.306		2.340				3.921	2.80
	Range	2.190-		--				--	2.386-
		4.94		--				--	3.36
	# Samples	5		1				1	3
Co	Mean	1.471		0.594				0.334	0.882
	Range	0.547-		--				--	0.68-
		4.306		--				--	1.10
	# Samples	5		1				1	3
Ni	Mean	3.272		2.118				15.519	2.671
	Range	2.324-		--				--	2.288-
		6.884		--				--	3.372
	# Samples	4		1				1	3
Cr	Mean	3.304		3.233				2.487	4.131
	Range	2.607-		--				--	3.771-
		4.110		--				--	4.389
	# Samples	5		1				1	3
Al	Mean	300.17		221.29				331.66	497.55
	Range	47.976-		--				--	72.063-
		467.46		--				--	751.86
	# Samples	5		1				1	3
V	Mean	14.633		19.509				10.760	14.156
	Range	12.341-		--				--	10.938-
		18.496		--				--	18.554
	# Samples	5		1				1	3

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - viscera & foot — µgm/gm Dry Weight

		E	C	D	G	B	A	H
Fe	Mean		872.38					
	Range		--					
			--					
	# Samples		1					
Cu	Mean		8.574					
	Range		--					
			--					
	# Samples		1					
Zn	Mean		71.563					
	Range		--					
			--					
	# Samples		1					
Cd	Mean		42.87					
	Range		--					
			--					
	# Samples		1					
Ag	Mean		0.504					
	Range		--					
			--					
	# Samples		1					
Mn	Mean		26.39					
	Range		--					
			--					
	# Samples		1					
Pb	Mean		3.602					
	Range		--					
			--					
	# Samples		1					
Co	Mean		0.961					
	Range		--					
			--					
	# Samples		1					
Ni	Mean		1.993					
	Range		--					
			--					
	# Samples		1					
Cr	Mean		4.659					
	Range		--					
			--					
	# Samples		1					
Al	Mean		396.73					
	Range		--					
			--					
	# Samples		1					
V	Mean		21.133					
	Range		--					
			--					
	# Samples		1					

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - viscera & foot — µgm/gm Ash Weight

		14	9	17	1	2	5	8	11
Fe	Mean	3119.0		3932.0				5013.0	8798.0
	Range	1385.0-		--				--	6443.0-
		4764.0		--				--	10292.0
	# Samples	5		1				1	3
Cu	Mean	27.77		81.18				29.10	47.94
	Range	22.28-		--				--	30.06-
		33.17		--				--	64.09
	# Samples	5		1				1	3
Zn	Mean	279.6		519.1				461.6	364.4
	Range	227.9-		--				--	317.9-
		360.0		--				--	431.4
	# Samples	5		1				1	3
Cd	Mean	291.8		289.6				116.14	614.6
	Range	239.73-		--				--	395.74-
		405.45		--				--	896.91
	# Samples	5		1				1	3
Ag	Mean	4.10		3.14				3.97	4.35
	Range	3.06-		--				--	3.61-
		5.48		--				--	4.88
	# Samples	5		1				1	3
Mn	Mean	107.6		82.10				242.06	297.9
	Range	70.75		--				--	190.24
		145.45		--				--	354.64
	# Samples	5		1				1	3
Pb	Mean	10.96		17.21				21.69	20.4
	Range	9.54-		--				--	16.91-
		12.00		--				--	26.80
	# Samples	5		1				1	3
Co	Mean	4.39		4.37				1.85	6.41
	Range	2.00-		--				--	4.95-
		10.37		--				--	8.76
	# Samples	5		1				1	3
Ni	Mean	14.006		15.574				85.85	19.071
	Range	9.903-		--				--	16.990-
		20.303		--				--	23.024
	# Samples	4		1				1	3
Cr	Mean	11.282		23.77				13.766	30.76
	Range	8.957-		--				--	22.114-
		12.121		--				--	42.612
	# Samples	5		1				1	3
Al	Mean	1037.65		1627.05				1834.66	3133.18
	Range	208.937-		--				--	725.00-
		1710.03		--				--	4885.85
	# Samples	5		1				1	3
V	Mean	50.294		143.443				59.524	101.33
	Range	37.415-		--				--	79.91-
		54.75		--				--	130.58
	# Samples	5		1				1	3

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - viscera & foot — µgm/gm Ash Weight

		E	C	D	G	B	A	H
Fe	Mean		5766.0					
	Range		--					
			--					
	# Samples		1					
Cu	Mean		56.67					
	Range		--					
			--					
	# Samples		1					
Zn	Mean		473.0					
	Range		--					
			--					
	# Samples		1					
Cd	Mean		283.33					
	Range		--					
			--					
	# Samples		1					
Ag	Mean		3.33					
	Range		--					
			--					
	# Samples		1					
Mn	Mean		174.44					
	Range		--					
			--					
	# Samples		1					
Pb	Mean		23.81					
	Range		--					
			--					
	# Samples		1					
Co	Mean		6.35					
	Range		--					
			--					
	# Samples		1					
Ni	Mean		13.175					
	Range		--					
			--					
	# Samples		1					
Cr	Mean		30.794					
	Range		--					
			--					
	# Samples		1					
Al	Mean		2622.22					
	Range		--					
			--					
	# Samples		1					
V	Mean		139.68					
	Range		--					
			--					
	# Samples		1					

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - total

µgm/gm Wet Weight

		14	9	17	1	2	5	8	11
Fe	Mean	84.75	36.13	6.439	79.07	40.11	123.69	121.029	167.23
	Range	44.05-	--	--	75.44-	--	17.12-	--	143.36-
		119.91	--	--	82.69	--	230.25	--	200.75
	# Samples	5	1	1	2	1	2	1	3
Cu	Mean	0.82	0.972	1.405	0.90	0.721	1.32	0.782	0.92
	Range	0.74-	--	--	0.80-	--	0.94-	--	0.68-
		0.93	--	--	1.00	--	1.70	--	1.13
	# Samples	5	1	1	2	1	2	1	3
Zn	Mean	11.97	--	14.88	14.85	18.04	27.87	14.913	12.27
	Range	9.28-	--	--	12.84-	--	20.99	--	11.37-
		15.05	--	--	16.86	--	34.76	--	12.83
	# Samples	5	1	1	2	1	2	1	3
Cd	Mean	8.86	3.497	4.685	2.88	2.578	2.93	2.816	10.77
	Range	7.41-	--	--	2.76-	--	2.77-	--	8.18-
		11.46	--	--	3.00	--	3.08	--	12.35
	# Samples	5	1	1	2	1	2	1	3
Ag	Mean	0.12	--	0.074	0.20	0.154	0.16	0.1134	0.10
	Range	0.09-	--	--	0.17-	--	0.14-	--	0.07-
		0.15	--	--	9.22	--	0.19	--	0.12
	# Samples	5	1	1	2	1	2	1	3
Mn	Mean	3.35	--	1.523	5.19	2.653	13.30	6.050	6.22
	Range	2.36-	--	--	4.62-	--	2.90-	--	4.65-
		5.22	--	--	5.75	--	23.68	--	8.92
	# Samples	5	1	1	2	1	2	1	3
Pb	Mean	0.41	--	0.433	0.79	0.567	0.97	0.618	0.51
	Range	0.34-	--	--	0.62-	--	0.62-	--	0.49-
		0.48	--	--	0.96	--	1.32	--	0.53
	# Samples	5	1	1	2	1	2	1	3
Co	Mean	0.14	--	--	0.07	0.052	0.10	0.0661	0.12
	Range	0.07-	--	--	0.06-	--	0.08-	--	0.11-
		0.31	--	--	0.08	--	0.17	--	0.13
	# Samples	4	1	1	2	1	2	1	3
Ni	Mean	1.22	2.441	0.29	0.430	0.423	1.861	2.094	0.75
	Range	0.71-	--	--	0.365-	--	0.289-	--	0.39-
		1.77	--	--	0.494	--	3.430	--	1.30
	# Samples	3	1	1	2	1	2	1	3
Cr	Mean	1.04	0.302	0.43	0.325	0.248	0.473	0.3593	0.69
	Range	0.31-	--	--	0.271-	--	0.289-	--	0.53-
		2.91	--	--	0.378	--	0.657	--	0.95
	# Samples	4	1	1	2	1	2	1	3
Al	Mean	86.16	19.38	28.00	39.16	17.43	36.805	45.053	121.09
	Range	4.99-	--	--	30.369-	--	7.821-	--	88.19-
		306.91	--	--	47.951	--	65.789	--	174.13
	# Samples	5	1	1	2	1	2	1	3
V	Mean	1.42	1.59	2.35	2.030	1.341	1.795	1.482	1.86
	Range	1.34-	--	--	1.879-	--	1.709-	--	1.64-
		1.53	--	--	2.180	--	1.880	--	2.06
	# Samples	4	1	1	2	1	2	1	3

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - total

µgm/gm Wet Weight

		E	C	D	G	B	A	H
Fe	Mean		100.84		89.71			
	Range		--		--			
			--		--			
	# Samples		1		1			
Cu	Mean		1.09		0.738			
	Range		--		--			
			--		--			
	# Samples		1		1			
Zn	Mean		13.24		14.96			
	Range		--		--			
			--		--			
	# Samples		1		1			
Cd	Mean		4.415		2.95			
	Range		--		--			
			--		--			
	# Samples		1		1			
Ag	Mean		0.071		0.179			
	Range		--		--			
			--		--			
	# Samples		1		1			
Mn	Mean		2.946		4.423			
	Range		--		--			
			--		--			
	# Samples		1		1			
Pb	Mean		0.501		0.596			
	Range		--		--			
			--		--			
	# Samples		1		1			
Co	Mean		0.186		0.092			
	Range		--		--			
			--		--			
	# Samples		1		1			
Ni	Mean		8.41		0.321			
	Range		--		--			
			--		--			
	# Samples		1		1			
Cr	Mean		0.52		0.964			
	Range		--		--			
			--		--			
	# Samples		1		1			
Al	Mean		41.40		39.69			
	Range		--		--			
			--		--			
	# Samples		1		1			
V	Mean		2.16		1.24			
	Range		--		--			
			--		--			
	# Samples		1		1			

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - total

µgm/gm Dry Weight

		14	9	17	1	2	5	8	11
Fe	Mean	588.60	203.43	27.94	480.3	264.8	537.8	423.96	870.71
	Range	367.44-	--	--	476.62-	--	95.63-	--	700.17-
		765.91	--	--	483.81	--	979.96	--	1007.51
	# Samples	5	1	1	2	1	2	1	3
Cu	Mean	5.86	5.477	6.098	5.46	4.762	6.25	2.739	4.83
	Range	5.13-	--	--	5.15-	--	5.24-	--	3.40-
		7.03	--	--	5.77	--	7.26	--	6.48
	# Samples	5	1	1	2	1	2	1	3
Zn	Mean	86.91	89.24	64.54	89.74	119.04	141.75	52.239	54.84
	Range	64.49-	--	--	82.321-	--	89.34-	--	29.89-
		122.11	--	--	97.157	--	194.15	--	69.39
	# Samples	5	1	1	2	1	2	1	3
Cd	Mean	58.34	19.69	20.32	17.56	17.006	14.51	9.863	56.38
	Range	38.10-	--	--	15.913-	--	11.80-	--	41.07-
		92.62	--	--	19.210	--	17.22	--	67.70
	# Samples	5	1	1	2	1	2	1	3
Ag	Mean	0.84	2.879	0.329	1.21	1.02	0.79	0.398	0.51
	Range	0.69-	--	--	1.005-	--	0.77-	--	0.34-
		1.09	--	--	1.406	--	0.80	--	0.67
	# Samples	5	1	1	2	1	2	1	3
Mn	Mean	24.39	19.40	6.606	31.41	17.498	58.55	21.194	32.08
	Range	15.07-	--	--	29.653-	--	16.30-	--	24.77-
		42.63	--	--	33.166	--	100.80	--	44.78
	# Samples	5	1	1	2	1	2	1	3
Pb	Mean	2.43	4.58	1.882	4.74	3.742	4.54	2.209	2.68
	Range	1.05-	--	--	3.949-	--	3.48-	--	2.48-
		3.57	--	--	5.528	--	5.60	00	3.03
	# Samples	5	1	1	2	1	2	1	3
Co	Mean	1.05	0.377	0.315	0.43	0.34	0.46	0.232	0.64
	Range	0.50-	--	--	0.334-	--	0.18-	--	0.58-
		2.54	--	--	0.535	--	0.73	--	0.71
	# Samples	4	1	1	2	1	2	1	3
Ni	Mean	11.91	13.74	1.24	2.60	2.79	8.108	7.334	4.90
	Range	7.07-	--	--	2.343-	--	1.615-	--	3.22-
		15.73	--	--	2.848	--	14.60	--	6.03
	# Samples	3	1	1	2	1	2	1	3
Cr	Mean	3.88	1.699	1.86	1.96	1.63	2.207	1.259	3.51
	Range	1.87-	--	--	1.740-	--	1.615-	--	2.98-
		4.88	--	--	2.178	--	2.80	--	4.51
	# Samples	4	1	1	2	1	2	1	3
Al	Mean	207.62	109.07	121.47	235.58	114.97	161.84	157.831	359.28
	Range	46.90-	--	--	194.78-	--	43.686-	--	65.00-
		334.64	--	--	276.38	--	280.00	--	506.68
	# Samples	5	1	1	2	1	2	1	3
V	Mean	12.30	8.971	10.02	12.31	8.843	8.773	5.191	9.71
	Range	10.01-	--	--	12.048-	--	8.00-	--	8.16-
		13.86	--	--	12.563	--	9.545	--	11.83
	# Samples	4	1	1	2	1	2	1	3

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - total

µgm/gm Dry Weight

		E	C	D	G	B	A	H
Fe	Mean		510.38		548.56			
	Range		--		--			
			--		--			
	# Samples		1		1			
Cu	Mean		5.523		4.517			
	Range		--		--			
			--		--			
	# Samples		1		1			
Zn	Mean		67.01		91.47			
	Range		--		--			
			--		--			
	# Samples		1		1			
Cd	Mean		22.35		18.04			
	Range		--		--			
			--		--			
	# Samples		1		1			
Ag	Mean		0.363		1.095			
	Range		--		--			
			--		--			
	# Samples		1		1			
Mn	Mean		15.09		27.04			
	Range		--		--			
			--		--			
	# Samples		1		1			
Pb	Mean		2.536		3.647			
	Range		--		--			
			--		--			
	# Samples		1		1			
Co	Mean		0.947		0.561			
	Range		--		--			
			--		--			
	# Samples		1		1			
Ni	Mean		42.58		1.964			
	Range		--		--			
			--		--			
	# Samples		1		1			
Cr	Mean		2.65		5.89			
	Range		--		--			
			--		--			
	# Samples		1		1			
Al	Mean		209.52		242.70			
	Range		--		--			
			--		--			
	# Samples		1		1			
V	Mean		10.93		7.576			
	Range		--		--			
			--		--			
	# Samples		1		1			

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - total — µgm/gm Ash Weight

		14	9	17	1	2	5	8	11
Fe	Mean	2942.79	1670.0	2604.0	2883.0	1323.0	4062.2	4690.41	8151.45
	Range	1266.85-	--	--	2802.0-	--	700.3-	--	5888.21-
		4286.68	--	--	2964.0	--	7424.0	--	9437.25
	# Samples	5	1	1	2	1	2	1	3
Cu	Mean	26.47	44.96	53.70	32.89	23.81	46.75	28.179	43.91
	Range	21.06-	--	--	29.84-	--	38.44-	--	28.87-
		32.10	--	--	35.94	--	55.05	--	59.37
	# Samples	5	1	1	2	1	2	1	3
Zn	Mean	326.99	732.6	546.32	540.45	595.2	1049.30	477.060	406.29
	Range	256.57-	--	--	476.7-	--	676.8-	--	370.56-
		406.52	--	--	604.2	--	1421.7	--	458.88
	# Samples	5	1	1	2	1	2	1	3
Cd	Mean	265.95	161.63	228.27	105.10	85.03	107.74	108.807	553.55
	Range	214.72-	--	--	98.96-	--	89.39-	--	373.66-
		367.91	--	--	111.24	--	126.08	--	820.79
	# Samples	5	1	1	2	1	2	1	3
Ag	Mean	3.94	23.64	3.838	7.195	5.10	5.86	3.926	4.12
	Range	3.010-	--	--	6.25-	--	5.65-	--	3.54-
		5.30	--	--	8.14	--	6.06	--	4.42
	# Samples	5	1	1	2	1	2	1	3
Mn	Mean	107.06	159.30	88.56	188.98	87.41	441.50	222.96	277.31
	Range	66.98-	--	--	171.71-	--	119.35-	--	159.37-
		152.51	--	--	206.25	--	763.64	--	350.15
	# Samples	5	1	1	2	1	2	1	3
Pb	Mean	11.93	37.60	21.693	28.625	18.71	33.98	21.575	20.68
	Range	10.21-	--	--	22.87-	--	25.54-	--	17.74-
		13.32	--	--	34.38	--	42.42	--	26.29
	# Samples	5	1	1	2	1	2	1	3
Co	Mean	4.00	3.10	3.487	2.59	1.70	3 45	1.989	5.92
	Range	2.07-	--	--	2.08-	--	1.34-	--	4.81-
		9.12	--	--	3.10	--	5.56	--	8.15
	# Samples	5	1	1	2	1	2	1	3
Ni	Mean	59.69	112.78	13.01	15.637	13.95	61.217	80.575	22.51
	Range	20.92-	--	--	13.566-	--	11.828-	--	16.60-
		133.54	--	--	17.708	--	110.606	--	32.16
	# Samples	3	1	1	2	1	2	1	3
Cr	Mean	18.08	13.953	19.65	11.81	8.163	16.520	13.199	31.13
	Range	10.80-	--	--	10.078-	--	11.827-	--	19.93-
		32.87	--	--	13.542	--	21.212	--	43.07
	# Samples	4	1	1	2	1	2	1	3
Al	Mean	1016.84	895.35	1318.09	1423.33	574.83	1220.55	1725.74	1554.01
	Range	454.81-	--	--	1127.91-	--	319.89-	--	595.66-
		1583.77	--	--	1718.75	--	2121.21	--	3362.68
	# Samples	5	1	1	2	1	2	1	3
V	Mean	49.53	73.64	112.85	73.946	44.22	65.249	56.231	92.05
	Range	47.29-	--	--	69.767-	--	60.606-	--	75.34-
		51.65	--	--	78.125	--	69.892	--	120.37
	# Samples	4	1	1	2	1	2.	1	3

Metals Concentrations in Echinoderm and Mollusc Tissues

Pecten - total µgm/gm Ash Weight

		E	C	D	G	B	A	H
Fe	Mean		4492.0		2785.0			
	Range		--		--			
			--		--			
	# Samples		1		1			
Cu	Mean		48.61		22.93			
	Range		--		--			
			--		--			
	# Samples		1		1			
Zn	Mean		526.23		464.4			
	Range		--		--			
			--		--			
	# Samples		1		1			
Cd	Mean		243.83		91.60			
	Range		--		--			
			--		--			
	# Samples		1		1			
Ag	Mean		3.271		5.56			
	Range		--		--			
			--		--			
	# Samples		1		1			
Mn	Mean		155.45		137.32			
	Range		--		--			
			--		--			
	# Samples		1		1			
Pb	Mean		23.134		18.52			
	Range		--		--			
			--		--			
	# Samples		1		1			
Co	Mean		7.254		2.85			
	Range		--		--			
			--		--			
	# Samples		1		1			
Ni	Mean		178.04		9.972			
	Range		--		--			
			--		--			
	# Samples		1		1			
Cr	Mean		27.37		29.915			
	Range		--		--			
			--		--			
	# Samples		1		1			
Al	Mean		2267.42		1232.2			
	Range		--		--			
			--		--			
	# Samples		1		1			
V	Mean		119.84		38.462			
	Range		--		--			
			--		--			
	# Samples		1		1			

Metals Concentrations in Echinoderm and Mollusc Tissues

Polinices — µgm/gm Wet Weight

		14	9	17	1	2	5	8	11
Fe	Mean	85.115		99.63	64.014	85.53	93.29	96.10	
	Range	--		77.22-	--	56.22-	--	--	
		--		121.50	--	114.84	--	--	
	# Samples	1		2	1	2	1	1	
Cu	Mean	6.253		6.58	8.969	9.66	5.582	6.32	
	Range	--		3.48-	--	6.71-	--	--	
		--		9.68	--	12.60	--	--	
	# Samples	1		2	1	2	1	1	
Zn	Mean	54.869		31.62	46.086	34.94	45.396	47.284	
	Range	--		26.59-	--	32.25-	--	--	
		--		36.66	--	37.63	--	--	
	# Samples	1		2	1	2	1	1	
Cd	Mean	0.340		0.77	0.53	0.92	0.286	0.838	
	Range	--		0.64-	--	0.53-	--	--	
		--		0.89	--	1.31	--	--	
	# Samples	1		2	1	2	1	1	
Ag	Mean	0.244		0.09	0.144	0.42	0.277	0.285	
	Range	--		0.05-	--	0.37-	--	--	
		--		0.13	--	0.47	--	--	
	# Samples	1		2	1	2	1	1	
Mn	Mean	3.024		4.83	4.827	6.74	1.017	3.015	
	Range	--		3.26-	--	6.25	--	--	
		--		6.40	00	7.23	--	--	
	# Samples	1		2	1	2	1	1	
Pb	Mean	1.407		0.95	0.585	1.36	0.764	0.948	
	Range	--		0.75-	--	1.04-	--	--	
		--		1.15	--	1.68	--	--	
	# Samples	1		2	1	2	1	1	
Co	Mean	0.078		0.18	0.109	0.02	0.091	0.039	
	Range	--		0.07-	--	0.02-	00	00	
		--		0.29	--	0.02	--	--	
	# Samples	1		2	1	2	1	1	
Ni	Mean	1.358		1.409	0.633	0.985	0.936	0.421	
	Range	--		0.955-	--	0.64-	--	--	
		--		1.862	--	1.33	--	--	
	# Samples	1		2	1	2	1	1	
Cr	Mean	0.474		0.335	0.446	0.35	0.311	0.290	
	Range	--		0.329-	--	0.27-	--	--	
		--		0.342	--	0.43	--	--	
	# Samples	1		2	1	2	1	1	
Al	Mean	14.879		21.65	6.446	28.92	25.96	24.53	
	Range	--		19.90-	--	13.71-	--	--	
		--		23.40	--	44.129	--	--	
	# Samples	1		2	1	2	1	1	
V	Mean	0.518		0.923	0.467	0.498	0.483	0.483	
	Range	--		0.774-	--	0.405-	--	--	
		--		1.071	--	0.591	--	--	
	# Samples	1		2	1	2	1	1	

Metals Concentrations in Echinoderm and Mollusc Tissues

Polinices

µmg/gm Wet Weight

		E	C	D	G	B	A	H
Fe	Mean		111.43			59.85		
	Range		--			--		
			--			--		
	# Samples		1			1		
Cu	Mean		7.152			6.782		
	Range		--			--		
			--			--		
	# Samples		1			1		
Zn	Mean		29.483			128.12		
	Range		--			--		
			--			--		
	# Samples		1			1		
Cd	Mean		0.52			0.89		
	Range		--			--		
			--			--		
	# Samples		1			--		
Ag	Mean		0.212			0.103		
	Range		--			--		
			--			--		
	# Samples		1			1		
Mn	Mean		7.928			0.645		
	Range		--			--		
			--			--		
	# Samples		1			1		
Pb	Mean		1.001			0.807		
	Range		--			--		
			--			--		
	# Samples		1			1		
Co	Mean		0.099			0.066		
	Range		--			--		
			--			--		
	# Samples		1			1		
Ni	Mean		0.683			1.26		
	Range		--			--		
			--			--		
	# Samples		1			1		
Cr	Mean		0.372			0.327		
	Range		--			--		
			--			--		
	# Samples		1			1		
Al	Mean		20.851			8.736		
	Range		--			--		
			--			--		
	# Samples		1			1		
V	Mean		0.508			1.679		
	Range		--			--		
			--			--		
	# Samples		1			1		

Metals Concentrations in Echinoderm and Mollusc Tissues

Polinices

µgm/gm Dry Weight

		14	9	17	1	2	5	8	11
Fe	Mean	299.36		330.36	215.8	240.05	284.89	281.42	
	Range	--		236.71-	--	194.33-	--	--	
		--		424.01	--	285.16	--	--	
	# Samples	1		2	1	2	1	1	
Cu	Mean	18.32		20.91	30.236	27.30	17.046	18.52	
	Range	--		12.15-	--	23.22-	--	--	
		--		29.67	--	31.37	--	--	
	# Samples	1		2	1	2	1	1	
Zn	Mean	160.75		102.6	155.36	102.5	138.63	138.46	
	Range	--		92.78-	--	93.62-	--	--	
		--		112.37	--	111.46	--	--	
	# Samples	1		2	1	2	1	1	
Cd	Mean	0.998		2.54	1.79	2.92	0.875	2.454	
	Range	--		1.97-	--	1.32-	--	--	
		--		3.10	--	4.51	--	--	
	# Samples	1		2	1	2	1	1	
Ag	Mean	0.716		0.30	0.487	1.22	0.846	0.835	
	Range	--		0.16-	--	1.17-	--	--	
		--		0.44	--	1.28	--	--	
	# Samples	1		2	1	2	1	1	
Mn	Mean	8.859		16.2	16.273	19.8	3.107	8.828	
	Range	--		10.00-	--	17.99-	--	--	
		--		22.35	--	21.59	--	--	
	# Samples	1		2	1	2	1	1	
Pb	Mean	4.121		3.07	1.971	3.88	2.335	2.775	
	Range	--		2.63-	--	3.59-	--	--	
		--		3.51	--	4.17	--	--	
	# Samples	1		2	1	2	1	1	
Co	Mean	0.227		0.60	0.369	0.06	0.277	0.115	
	Range	--		0.20-	--	0.05-	--	--	
		--		1.01	--	0.07	--	--	
	# Samples	1		2	1	2	1	1	
Ni	Mean	3.980		4.52	2.134	3.08	2.857	1.234	
	Range	--		3.33-	--	1.57-	--	--	
		--		5.71	--	4.60	00	00	
	# Samples	1		2	1	2	1	1	
Cr	Mean	1.388		1.10	1.504	1.01	0.949	-.848	
	Range	--		1.01-	--	0.93-	--	--	
		--		1.19	--	1.08	--	--	
	# Samples	1		2	1	2	1	1	
Al	Mean	43.59		70.59	21.73	78.60	79.274	71.83	
	Range	--		69.46-	--	47.39-	--	--	
		--		71.72	--	109.80	--	--	
	# Samples	1		2	1	2	1	1	
V	Mean	1.518		2.99	1.573	1.44	1.476	1.414	
	Range	--		2.70-	--	1.40-	--	--	
		--		3.28	--	1.47	--	--	
	# Samples	1		2	1	2	1	1	

Metals Concentrations in Echinoderm and Mollusc Tissues

	Polinices							µgm/gm Dry Weight
		E	C	D	G	B	A	H
Fe	Mean		392.05			182.68		
	Range		--			--		
			--			--		
	# Samples		1			1		
Cu	Mean		25.165			20.701		
	Range		--			--		
			--			--		
	# Samples		1			1		
Zn	Mean		103.727			391.04		
	Range		--			--		
			--			--		
	# Samples		1			1		
Cd	Mean		1.836			2.717		
	Range		--			--		
			--			--		
	# Samples		1			1		
Ag	Mean		0.745			0.313		
	Range		--			--		
			--			--		
	# Samples		1			1		
Mn	Mean		27.89			1.970		
	Range		--			--		
			--			--		
	# Samples		1			1		
Pb	Mean		3.524			2.465		
	Range		--			--		
			--			--		
	# Samples		1			1		
Co	Mean		0.347			0.202		
	Range		--			--		
			--			--		
	# Samples		1			1		
Ni	Mean		2.40			3.850		
	Range		--			--		
			--			--		
	# Samples		1			1		
Cr	Mean		1.31			0.998		
	Range		--			--		
			--			--		
	# Samples		1			1		
Al	Mean		73.36			26.665		
	Range		--			--		
			--			--		
	# Samples		1			1		
V	Mean		1.787			5.124		
	Range		--			--		
			--			--		
	# Samples		1			1		

Metals Concentrations in Echinoderm and Mollusc Tissues

	Polinices							µgm/gm Ash Weight
		14	9	17	1	2	5	8	11
Fe	Mean	1926.0		3481.0	2158.0	2071.0	2681.0	3174.0	
	Range	--		2003.0-	--	1713.0-	--	--	
		--		4960.0	--	2429.0	--	--	
	# Samples	1		2	1	2	1	1	
Cu	Mean	141.5		196.60	302.36	235.69	160.417	208.9	
	Range	--		142.14-	--	204.7-	--	--	
		--		251.07	--	266.67	--	--	
	# Samples	1		2	1	2	1	1	
Zn	Mean	1241.6		1018.1	1553.6	889.1	1304.6	1561.6	
	Range	--		950.8-	--	795.8-	--	--	
		--		1085.4	--	982.5	--	--	
	# Samples	1		2	1	2	1	1	
Cd	Mean	7.71		26.48	17.90	25.51	8.23	27.68	
	Range	--		16.67-	--	11.25-	--	--	
		--		36.29	--	39.78	--	--	
	# Samples	1		2	1	2	1	1	
Ag	Mean	5.53		3.32	4.87	10.64	9.52	9.42	
	Range	--		1.40-	--	10.00-	--	--	
		--		5.24	--	11.29	--	--	
	# Samples	1		2	1	2	1	1	
Mn	Mean	68.43		173.0	162.73	171.6	273.81	99.57	
	Range	--		84.62-	--	152.92-	--	--	
		--		261.42	--	190.32	--	--	
	# Samples	1		2	1	2	1	1	
Pb	Mean	31.83		30.2	19.71	33.56	26.88	31.30	
	Range	--		29.70-	--	31.69-	--	--	
		--		30.71	--	35.42	--	--	
	# Samples	1		2	1	2	1	1	
Co	Mean	1.76		6.77	3.69	0.52	1.49	1.30	
	Range	--		1.71-	--	0.42-	--	--	
		--		11.83	--	0.62	--	--	
	# Samples	1		2	1	2	1	1	
Ni	Mean	30.737		43.64	21.34	26.93	26.885	13.913	
	Range	--		38.98-	--	13.33-	--	--	
		--		48.29	--	40.53	--	--	
	# Samples	1		2	1	2	1	1	
Cr	Mean	10.72		11.27	15.04	8.70	8.929	9.565	
	Range	--		8.55-	--	8.23-	--	--	
		--		13.98	--	9.17	--	--	
	# Samples	1		2	1	2	1	1	
Al	Mean	336.68		709.67	217.31	675.51	746.03	810.15	
	Range	--		606.84-	--	417.69-	--	--	
		--		812.5	--	933.33	--	--	
	# Samples	1		2	1	2	1	1	
V	Mean	11.725		29.69	15.73	12.425	13.889	15.94	
	Range	--		27.78-	--	12.35-	--	--	
		--		31.59	--	12.5	--	--	
	# Samples	1		2	1	2	1.	1	

Metals Concentrations in Echinoderm and Mollusc Tissues

Polinices — µgm/gm Ash Weight

		E	C	D	G	B	A	H
Fe	Mean		3105.0			1810.0		
	Range		--			--		
			--			--		
	# Samples		1			1		
Cu	Mean		199.30			205.10		
	Range		--			--		
			--			--		
	# Samples		1			1		
Zn	Mean		821.5			3874.4		
	Range		--			--		
			--			--		
	# Samples		1			1		
Cd	Mean		14.54			26.92		
	Range		--			--		
			--			--		
	# Samples		1			1		
Ag	Mean		5.90			3.11		
	Range		--			--		
			--			--		
	# Samples		1			1		
Mn	Mean		220.91			91.52		
	Range		--			--		
			--			--		
	# Samples		1			1		
Pb	Mean		27.91			24.42		
	Range		--			--		
			--			--		
	# Samples		1			1		
Co	Mean		2.75			2.00		
	Range		--			--		
			--			--		
	# Samples		1			1		
Ni	Mean		19.025			38.14		
	Range		--			--		
			--			--		
	# Samples		1			1		
Cr	Mean		10.377			9.886		
	Range		--			--		
			--			--		
	# Samples		1			1		
Al	Mean		580.97			264.19		
	Range		--			--		
			--			--		
	# Samples		1			1		
V	Mean		14.151			50.768		
	Range		--			--		
			--			--		
	# Samples		1			1		

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - viscera & foot — µgm/gm Wet Weight

		14	9	17	1	2	5	8	11
Fe	Mean		130.44						
	Range		--						
			--						
	# Samples		1						
Cu	Mean		1.343						
	Range		--						
			--						
	# Samples		1						
Zn	Mean		12.605						
	Range		--						
			--						
	# Samples		1						
Cd	Mean		0.075						
	Range		--						
			--						
	# Samples		1						
Ag	Mean		0.484						
	Range		--						
			--						
	# Samples		1						
Mn	Mean		5.590						
	Range		--						
			--						
	# Samples		1						
Pb	Mean		0.474						
	Range		--						
			--						
	# Samples		1						
Co	Mean		0.414						
	Range		--						
			--						
	# Samples		1						
Ni	Mean		0.529						
	Range		--						
			--						
	# Samples		1						
Cr	Mean		0.484						
	Range		--						
			--						
	# Samples		1						
Al	Mean		48.89						
	Range		--						
			--						
	# Samples		1						
V	Mean		0.688						
	Range		--						
			--						
	# Samples		1						

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - viscera & foot

µgm/gm Wet Weight

		E	C	D	G	B	A	H
Fe	Mean							189.01
	Range							--
								--
	# Samples							1
Cu	Mean							0.653
	Range							--
								--
	# Samples							1
Zn	Mean							12.855
	Range							--
								--
	# Samples							1
Cd	Mean							0.132
	Range							--
								--
	# Samples							1
Ag	Mean							0.704
	Range							--
								--
	# Samples							1
Mn	Mean							10.507
	Range							--
								--
	# Samples							1
Pb	Mean							0.673
	Range							--
								--
	# Samples							1
Co	Mean							0.464
	Range							--
								--
	# Samples							1
Ni	Mean							0.483
	Range							--
								--
	# Samples							1
Cr	Mean							0.881
	Range							--
								--
	# Samples							1
Al	Mean							144.02
	Range							--
								--
	# Samples							1
V	Mean							1.259
	Range							--
								--
	# Samples							1

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - viscera & foot — µgm/gm Dry Weight

		14	9	17	1	2	5	8	11
Fe	Mean		586.77						
	Range		--						
			--						
	# Samples		1						
Cu	Mean		6.042						
	Range		--						
			--						
	# Samples		1						
Zn	Mean		56.701						
	Range		--						
			--						
	# Samples		1						
Cd	Mean		0.337						
	Range		--						
			--						
	# Samples		1						
Ag	Mean		2.176						
	Range		--						
			--						
	# Samples		1						
Mn	Mean		25.14						
	Range		--						
			--						
	# Samples		1						
Pb	Mean		2.130						
	Range		--						
			--						
	# Samples		1						
Co	Mean		1.861						
	Range		--						
			--						
	# Samples		1						
Ni	Mean		2.383						
	Range		--						
			--						
	# Samples		1						
Cr	Mean		2.176						
	Range		--						
			--						
	# Samples		1						
Al	Mean		219.93						
	Range		--						
			--						
	# Samples		1						
V	Mean		3.093						
	Range		--						
			--						
	# Samples		1						

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula

µgm/gm Dry Weight

		E	C	D	G	B	A	H
Fe	Mean							720.97
	Range							--
	# Samples							--
								1
Cu	Mean							2.491
	Range							--
	# Samples							--
								1
Zn	Mean							49.04
	Range							--
	# Samples							--
								1
Cd	Mean							0.505
	Range							--
	# Samples							--
								1
Ag	Mean							2.687
	Range							--
	# Samples							--
								1
Mn	Mean							40.078
	Range							--
	# Samples							--
								1
Pb	Mean							2.567
	Range							--
	# Samples							--
								1
Co	Mean							1.771
	Range							--
	# Samples							--
								1
Ni	Mean							1.841
	Range							--
	# Samples							--
								1
Cr	Mean							3.362
	Range							--
	# Samples							--
								1
Al	Mean							549.38
	Range							--
	# Samples							--
								1
V	Mean							4.803
	Range							--
	# Samples							--
								1

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - viscera & foot

µgm/gm Ash Weight

		14	9	17	1	2	5	8	11
Fe	Mean		46.91						
	Range		--						
			--						
	# Samples		1						
Cu	Mean		48.30						
	Range		--						
			--						
	# Samples		1						
Zn	Mean		4533.0						
	Range		--						
			--						
	# Samples		1						
Cd	Mean		2.70						
	Range		--						
			--						
	# Samples		1						
Ag	Mean		17.40						
	Range		--						
			--						
	# Samples		1						
Mn	Mean		201.01						
	Range		--						
			--						
	# Samples		1						
Pb	Mean		17.03						
	Range		--						
			--						
	# Samples		1						
Co	Mean		14.88						
	Range		--						
			--						
	# Samples		1						
Ni	Mean		19.048						
	Range		--						
			--						
	# Samples		1						
Cr	Mean		17.399						
	Range		--						
			--						
	# Samples		1						
Al	Mean		1758.2						
	Range		--						
			--						
	# Samples		1						
V	Mean		24.725						
	Range		--						
			--						
	# Samples		1						

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - viscera &foot — µgm/gm Ash Weight

		E	C	D	G	B	A	H
Fe	Mean							7747.0
	Range							--
								--
	# Samples							1
Cu	Mean							26.77
	Range							--
								--
	# Samples							1
Zn	Mean							526.9
	Range							--
								--
	# Samples							1
Cd	Mean							5.43
	Range							--
								--
	# Samples							1
Ag	Mean							28.87
	Range							--
								--
	# Samples							1
Mn	Mean							430.65
	Range							--
								--
	# Samples							1
Pb	Mean							27.58
	Range							--
								--
	# Samples							1
Co	Mean							19.03
	Range							--
								--
	# Samples							1
Ni	Mean							19.785
	Range							--
								--
	# Samples							1
Cr	Mean							36.129
	Range							--
								--
	# Samples							1
Al	Mean							5903.2
	Range							--
								--
	# Samples							1
V	Mean							51.613
	Range							--
								--
	# Samples							1

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - muscle only — µgm/gm Wet Weight

		14	9	17	1	2	5	8	11
Fe	Mean		27.56						
	Range		--						
			--						
	# Samples		1						
Cu	Mean		0.331						
	Range		--						
			--						
	# Samples		1						
Zn	Mean		10.565						
	Range		--						
			--						
	# Samples		1						
Cd	Mean		0.018						
	Range		--						
			--						
	# Samples		1						
Ag	Mean		0.033						
	Range		--						
			--						
	# Samples		1						
Mn	Mean		0.2[illegible]7						
	Range		--						
			--						
	# Samples		1						
Pb	Mean		0.380						
	Range		--						
			--						
	# Samples		1						
Co	Mean		0.059						
	Range		--						
			--						
	# Samples		1						
Ni	Mean		2.102						
	Range		--						
			--						
	# Samples		1						
Cr	Mean		0.067						
	Range		--						
			--						
	# Samples		1						
Al	Mean		2.567						
	Range		--						
			--						
	# Samples		1						
V	Mean		0.037						
	Range		--						
			--						
	# Samples		1						

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - muscle only — µgm/gm Wet Weight

		E	C	D	G	B	A	H
Fe	Mean							39.77
	Range							--
								--
	# Samples							1
Cu	Mean							0.264
	Range							--
								--
	# Samples							1
Zn	Mean							9.964
	Range							--
								--
	# Samples							1
Cd	Mean							0.023
	Range							--
								--
	# Samples							1
Ag	Mean							0.069
	Range							--
								--
	# Samples							1
Mn	Mean							0.920
	Range							--
								--
	# Samples							1
Pb	Mean							0.249
	Range							--
								--
	# Samples							1
Co	Mean							0.061
	Range							--
								--
	# Samples							1
Ni	Mean							0.257
	Range							--
								--
	# Samples							1
Cr	Mean							0.115
	Range							--
								--
	# Samples							1
Al	Mean							10.27
	Range							--
								--
	# Samples							1
V	Mean							0.115
	Range							--
								--
	# Samples							1

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - muscle only — µgm/gm Dry Weight

		14	9	17	1	2	5	8	11
Fe	Mean		105.56						
	Range		--						
			--						
	# Samples		1						
Cu	Mean		1.268						
	Range		--						
			--						
	# Samples		1						
Zn	Mean		40.455						
	Range		--						
			--						
	# Samples		1						
Cd	Mean		0.071						
	Range		--						
			--						
	# Samples		1						
Ag	Mean		0.128						
	Range		--						
			--						
	# Samples		1						
Mn	Mean		1.022						
	Range		--						
			--						
	# Samples		1						
Pb	Mean		1.453						
	Range		--						
			--						
	# Samples		1						
Co	Mean		0.227						
	Range		--						
			--						
	# Samples		1						
Ni	Mean		8.048						
	Range		--						
			--						
	# Samples		1						
Cr	Mean		0.256						
	Range		--						
			--						
	# Samples		1						
Al	Mean		9.829						
	Range		--						
			--						
	# Samples		1						
V	Mean		0.142						
	Range		--						
			--						
	# Samples		1						

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - muscle only — gm/gm/ Dry Weight

		E	C	D	G	B	A	H
Fe	Mean							156.12
	Range							--
								--
	# Samples							1
Cu	Mean							1.038
	Range							--
								--
	# Samples							1
Zn	Mean							39.11
	Range							--
								--
	# Samples							1
Cd	Mean							0.090
	Range							--
								--
	# Samples							1
Ag	Mean							0.271
	Range							--
								--
	# Samples							1
Na	Mean							3.610
	Range							--
								--
	# Samples							1
Pb	Mean							0.977
	Range							--
								--
	# Samples							1
Co	Mean							0.240
	Range							--
								--
	# Samples							1
Ni	Mean							1.008
	Range							--
								--
	# Samples							1
Cr	Mean							0.451
	Range							--
								--
	# Samples							1
Al	Mean							40.31
	Range							--
								--
	# Samples							1
V	Mean							0.451
	Range							--
								--
	# Samples							1

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - muscle only — µgm/gm Ash Weight

		14	9	17	1	2	5	8	11
Fe	Mean		1604.0						
	Range		--						
			--						
	# Samples		1						
Cu	Mean		19.26						
	Range		--						
			--						
	# Samples		1						
Zn	Mean		614.7						
	Range		--						
			--						
	# Samples		1						
Cd	Mean		1.08						
	Range		--						
			--						
	# Samples		1						
Ag	Mean		1.95						
	Range		--						
			--						
	# Samples		1						
Mn	Mean		15.53						
	Range		--						
			--						
	# Samples		1						
Pb	Mean		22.08						
	Range		--						
			--						
	# Samples		1						
Co	Mean		3.46						
	Range		--						
			--						
	# Samples		1						
Ni	Mean		122.29						
	Range		--						
			--						
	# Samples		1						
Cr	Mean		3.89						
	Range		--						
			--						
	# Samples		1						
Al	Mean		149.35						
	Range		--						
			--						
	# Samples		1						
V	Mean		2.164						
	Range		--						
			--						
	# Samples		1						

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - muscle only

µgm/gm/ Ash Weight

		E	C	D	G	B	A	H
Fe	Mean							2621.0
	Range							--
								--
	# Samples							1
Cu	Mean							17.42
	Range							--
								--
	# Samples							1
Zn	Mean							656.6
	Range							--
								--
	# Samples							1
Cd	Mean							1.52
	Range							--
								--
	# Samples							1
Ag	Mean							4.55
	Range							--
								--
	# Samples							1
Mn	Mean							60.61
	Range							--
								--
	# Samples							1
Pb	Mean							16.41
	Range							--
								--
	# Samples							1
Co	Mean							4.04
	Range							--
								--
	# Samples							1
Ni	Mean							16.919
	Range							--
								--
	# Samples							1
Cr	Mean							7.576
	Range							--
								--
	# Samples							1
Al	Mean							676.77
	Range							--
								--
	# Samples							1
V	Mean							7.576
	Range							--
								--
	# Samples							1

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - total — µgm/gm/ Wet Weight

		14	9	17	1	2	5	8	11
Fe	Mean		104.21	49.50					
	Range		--	36.09-					
			--	62.23					
	# Samples		1	4					
Cu	Mean		1.084	1.20					
	Range		--	0.87-					
			--	1.57					
	# Samples		1	4					
Zn	Mean		12.084	14.30					
	Range		--	12.38-					
			--	17.42					
	# Samples		1	4					
Cd	Mean		0.06	0.13					
	Range		--	0.05-					
			--	0.28					
	# Samples		1	4					
Ag	Mean		0.368	0.20					
	Range		--	0.15-					
			--	0.28					
	# Samples		1	4					
Mn	Mean		4.232	2.13					
	Range		--	1.53-					
			--	3.67					
	# Samples		1	4					
Pb	Mean		0.450	0.85					
	Range		--	0.58-					
			--	1.60					
	# Samples		1	4					
Co	Mean		0.458	0.16					
	Range		--	0.06-					
			--	0.38					
	# Samples		1	4					
Ni	Mean		0.93	1.44					
	Range		--	1.373-					
			--	1.549					
	# Samples		1	3					
Cr	Mean		0.38	0.28					
	Range		--	0.248-					
			--	0.301					
	# Samples		1	3					
Al	Mean		37.08	19.06					
	Range		--	12.73-					
			--	25.094					
	# Samples		1	3					
V	Mean		0.52	0.55					
	Range		--	0.334-					
			--	0.838					
	# Samples		1	3					

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - total

µgm/gm Wet Weight

		E	C	D	G	B	A	H
Fe	Mean				102.43			150.95
	Range				--			--
					--			----
	# Samples				1			1
Cu	Mean				0.656			0.553
	Range				--			--
					--			--
	# Samples				1			1
Zn	Mean				12.388			12.117
	Range				--			--
					--			--
	# Samples				1			1
Cd	Mean				0.052			0.097
	Range				--			--
					--			--
	# Samples				1			1
Ag	Mean				0.250			0.542
	Range				--			--
					--			--
	# Samples				1			1
Mn	Mean				3.981			8.062
	Range				--			--
					--			--
	# Samples				1			1
Pb	Mean				0.473			0.564
	Range				--			--
					--			--
	# Samples				1			1
Co	Mean				0.171			0.361
	Range				--			--
					--			--
	# Samples				1			1
Ni	Mean				0.361			0.31
	Range				--			--
					--			--
	# Samples				1			1
Cr	Mean				0.271			0.31
	Range				--			--
					--			--
	# Samples				1			1
Al	Mean				38.577			44.38
	Range				--			--
					--			--
	# Samples				1			1
V	Mean				0.333			11.21
	Range				--			--
					--			--
	# Samples				1			1

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - total — µgm/gm Dry Weight

		14	9	17	1	2	5	8	11
Fe	Mean		448.776	209.39					
	Range		--	93.34-					
			--	259.86					
	# Samples		1	4					
Cu	Mean		4.673	4.75					
	Range		--	0.68-					
			--	7.33					
	# Samples		1	4					
Zn	Mean		430.11	68.05					
	Range		--	64.57-					
			--	71.24					
	# Samples		1	4					
Cd	Mean		0.260	0.575					
	Range		--	0.24-					
			--	1.14					
	# Samples		1	4					
Ag	Mean		1.588	0.933					
	Range		--	0.79-					
			--	1.14					
	# Samples		1	4					
Mn	Mean		18.223	9.82					
	Range		--	8.05-					
			--	14.17					
	# Samples		1	4					
Pb	Mean		1.935	3.91					
	Range		--	3.03-					
			--	6.44					
	# Samples		1	4					
Co	Mean		1.392	0.728					
	Range		--	0.31-					
			--	1.52					
	# Samples		1	4					
Ni	Mean		4.01	7.33					
	Range		--	6.512-					
			--	8.135					
	# Samples		1	3					
Cr	Mean		1.63	1.41					
	Range		--	1.324-					
			--	1.583					
	# Samples		1	3					
Al	Mean		159.29	95.59					
	Range		--	68.19-					
			--	116.998					
	# Samples		1	3					
V	Mean		2.21	2.80					
	Range		--	1.790-					
			--	4.397					
	# Samples		1	3					

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - total

µgm/gm Dry Weight

		E	C	D	G	B	A	H
Fe	Mean				434.24			579.98
	Range				--			--
					--			--
	# Samples				1			1
Cu	Mean				2.781			541.27
	Range				--			--
					--			--
	# Samples				1			1
Zn	Mean				52.52			46.561
	Range				--			--
					--			--
	# Samples				1			1
Cd	Mean				0.222			0.401
	Range				--			--
					--			--
	# Samples				1			1
Ag	Mean				1.058			2.083
	Range				--			--
					--			--
	# Samples				1			1
Mn	Mean				16.878			30.975
	Range				--			--
					--			--
	# Samples				1			1
Pb	Mean				2.005			1.572
	Range				--			--
					--			--
	# Samples				1			1
Co	Mean				0.726			1.388
	Range				--			--
					--			--
	# Samples				1			1
Ni	Mean				1.532			1.22
	Range				--			--
					--			--
	# Samples				1			1
Cr	Mean				1.149			29.11
	Range				--			--
					--			--
	# Samples				1			1
Al	Mean				163.54			167.38
	Range				--			--
					--			--
	# Samples				1			1
V	Mean				1.411			1.54
	Range				--			--
					--			--
	# Samples				1			1

Metals Concentrations in Echinoderm and Mollusc Tissues

Spisula - total — µgm/gm Ash Weight

		14	9	17	1	2	5	8	11
Fe	Mean		4152.0	1664.0					
	Range		--	1076.0-					
			--	2754.0					
	# Samples		1	4					
Cu	Mean		26.50	38.81					
	Range		--	26.09-					
			--	50.00					
	# Samples		1	4					
Zn	Mean		469.50	479.3					
	Range		--	369.1-					
			--	770.8					
	# Samples		1	4					
Cd	Mean		2.537	4.79					
	Range		--	1.36-					
			--	12.50					
	# Samples		1	4					
Ag	Mean		15.849	6.78					
	Range		--	4.35-					
			--	12.50					
	# Samples		1	4					
Mn	Mean		182.39	133.32					
	Range		--	45.52-					
			--	277.17					
	# Samples		1	4					
Pb	Mean		17.537	29.90					
	Range		--	13.68-					
			--	70.83					
	# Samples		1	4					
Co	Mean		13.734	6.43					
	Range		--	1.74-					
			--	16.67					
	# Samples		1	4					
Ni	Mean		29.41	41.59					
	Range		--	37.82-					
			--	46.19					
	# Samples		1	3					
Cr	Mean		16.04	8.02					
	Range		--	7.42-					
			--	8.96					
	# Samples		1	3					
Al	Mean		1596.76	544.55					
	Range		--	379.53-					
			--	679.49					
	# Samples		1	3					
V	Mean		22.46	15.89					
	Range		--	9.964-					
			--	24.876					
	# Samples		1	3					

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Metals Concentrations in Echinoderm and Mollusc Tissues

µgm/gm Ash Weight

		E	C	D	G	B	A	H
Fe	Mean				4489.0			6847.2
	Range				--			--
					--			--
	# Samples				1			1
Cu	Mean				28.75			25.13
	Range				--			--
					--			--
	# Samples				1			1
Zn	Mean				542.9			535.77
	Range				--			--
					--			--
	# Samples				1			1
Cd	Mean				2.29			5.16
	Range				--			--
					--			--
	# Samples				1			1
Ag	Mean				10.94			27.207
	Range				--			--
					--			--
	# Samples				1			1
Mn	Mean				174.48			405.351
	Range				--			--
					--			--
	# Samples				1			1
Pb	Mean				20.73			21.816
	Range				--			--
					--			--
	# Samples				1			1
Co	Mean				7.50			18.005
	Range				--			--
					--			--
	# Samples				1			1
Ni	Mean				15.833			17.11
	Range				--			--
					--			--
	# Samples				1			1
Cr	Mean				11.875			9.52
	Range				--			--
					--			--
	# Samples				1			1
Al	Mean				1690.63			1034.10
	Range				--			--
					--			--
	# Samples				1			1
V	Mean				14.583			10.59
	Range				--			--
					--			--
	# Samples				1			1